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Basis for Policy

It was wisely re-stated at a recent management conference as axiomatic that the policy of any manufacturing concern must, to be worth anything, be based on a three-cornered consideration of available facilities, the state of the market, and the cost of production. Available facilities are not necessarily those installed, but obtainable if warranted. The answer as to whether or not this be so, is to be derived from the conclusions drawn from a study of the market for the output and from an ascertainment of the costs of production. Most foundry executives have a good knowledge of the facilities they possess. They are cognisant of the maximum weight range and the types of metal they can handle, their machining potentialities, the ease with which they can meet customers' specifications, and their ability to honour delivery promises.

The market for their goods must be a variable. In the case of a small concern doing a local business, the main objective is to discover the credit-worthiness of the customers and the chances there are of increased or decreased business, or changes in design. The foundry owner may have to decide to go further afield for his business, whereupon all sorts of difficulties may arise, often amounting to such as would make his venture into a gamble. The larger companies are often faced with the problem of breaking new ground; may be, of accepting orders of a jobbing character—liable to interfere with a production line—or important ones necessitating new tooling-up. The former in their case is the more difficult to assess, as such business takes up much time of the high-grade staff, and this is not easy to cost accurately. What may appear superficially to be profitable may intrinsically result in a loss. Where new tooling-up is involved, provided reliable data are available, the gamble element—though ever present—is lessened.

For the successful culmination of any business deal, even though the executive be satisfied that the facilities are suitable and that the market conditions are favourable as to credit and expansion, there still remains the cost of production. Only too often nowadays this third factor is the stumbling block to a successful outcome of a project. Some founders, who have spent for the purpose of mechanization sums of the order of £1,000 per ton output per week, may find that the money has been badly or well invested and their competitive position is correspondingly weak or strong. In the former case, the search for appropriate markets will be arduous and throw a great strain on the sales department. However, for this state of affairs and where new plant is needed there is some promise of taxation relief in the Budget proposals. Small family businesses, too, will be encouraged to invest in new plant, as their tax condition is also to be alleviated. The new provisions should mean for all firms a reconsideration of policy on the tripedal basis postulated initially.

Correspondence

GRAPHITIC SPHERULITES

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We have recently read the paper entitled "Structure of Graphitic Spherulites,"[1] by M. N. Parthasarathi and B. R. Nijhawan, published in the JOURNAL. This contains a quotation removed from the context of our paper "Observations on Nodular Graphite,"[2] which gives a completely false impression of our views as presented at that time.

In our paper we presented a geometrical argument to demonstrate the untenability of the hypothesis of a spherical non-graphitic core. The relationship between the number of nodules possessing a bright central core, and the average core-diameter to nodule-diameter ratio was considered, and we made the statement, quoted by the above authors, that "measurements of a large number of nodules having central spots showed the average core diameter to be only about 10 per cent. of the diameter of the nodules." From the details of this argument it was clear that the 10 per cent. could only refer to the value of the core diameter to nodule diameter averaged over a large number of nodules, and involved no implications regarding deviations from the average.

Further in our paper, we discussed the "oriented graphite" model of the nodule which had previously been described by Morrogh and others,[3] and which we used to explain the structures observed in electron micrographs of nodules. Here, he considered variations in the core to nodule-diameter ratio and stated: "It has been observed[4] that, generally, larger cores were to be found in the smaller nodules in a given sample. This is to be expected on the basis of the model we have used since, when a nodule is sectioned near the periphery, the apparent diameter will be small, while the 'core' diameter will be near its maximum value for that nodule."

This is exactly what Parthasarathi and Nijhawan later found when they successively sectioned individual nodules, and it is surprising that they contend that a fundamental disagreement exists.

In the discussion of our paper,[5] we dealt with Mr. Parthasarathi and Mr. Nijhawan's failure to observe significant differences in smoothness of the nodules sectioned above and below the central plane, and we can only repeat that we observed these structural variations in electron micrographs, and since the structure is below the resolution of the light microscope, it is scarcely surprising that it was not observed in the work of Mr. Parthasarathi and Mr. Nijhawan.

We would appreciate having this letter published in order to correct the misinterpretation of our work contained in the paper[1] to which we refer.—Yours, etc.,

H. M. WELD,
R. L. CUNNINGHAM,
F. W. C. BOSWELL.

Department of Mines and Technical Surveys,
Physical Metallurgy Division,
568, Booth Street, Ottawa, Ontario.
March 19.

[1] M. N. Parthasarathi and B. R. Nijhawan, FOUNDRY TRADE JOURNAL 95 (1953) 809.
[2] H. M. Weld, R. L. Cunningham and F. W. C. Boswell, *Journal of Metals* 4 (1952) 738.
[3] H. Morrogh and W. J. Williams, *Journal* Iron and Steel Inst. 155 (1947) 321.
[4] J. E. Rehder, *American Foundryman* 21 (1952) 44.
[5] H. M. Weld, R. L. Cunningham and F.W.C. Boswell, *Journal of Metals* 5 (1953) 738.

THE INSTITUTE OF PHYSICS through its Non-destructive testing group is holding a summer meeting from July 7 to 10, Chancellor's Hall, University of Birmingham.

E.F. Co. Changes

On medical advice, Mr. W. S. Gifford resigned his position as joint managing director of Electric Furnace Company, Limited, on March 31. He is remaining on the board of the company and also on the boards of its subsidiaries, Electric Resistance Furnace Company, Limited, and Electro-Chemical Engineering Company, Limited.

The business was started in 1909, when Mr. D. F. Campbell was asked by Dr. Paul Héroult, who had invented the Héroult arc furnace, to undertake its exploitation in Great Britain. Mr. Gifford joined him at the end of 1909, and, in 1922, they formed a private company, Campbell, Gifford & Company, Limited; this later became a public company, Electric Furnace Company, Limited, of which Mr. Campbell and Mr. Gifford have been joint managing directors since its formation. Their activities were at first confined to arc furnaces, the first furnace in Great Britain being installed in 1910. Subsequently they acquired the British and certain Continental rights to the Ajax-Wyatt low-frequency and Ajax-Northrup high-frequency induction melting furnaces, and installed the first furnaces of these types in Europe. They also started designing electric-resistance furnaces and formed Electric Resistance Furnace Company, Limited, in 1929, to handle this part of their business.

Dinner

I.B.F. GOLDEN JUBILEE

The jubilee banquet of the Institute of British Foundrymen was held last Friday at the Café Royal, London, W.1, under the presidency of Mr. E. Longden, M.I.Mech.E. At the high table were: Mr. A. R. W. Low, C.B.E., D.S.O., M.P.; A. Brizon (Paris); Mr. F. Scones; Mr. V. Delport; Mr. John Bell; Sir Archibald Forbes; Professor J. C. Thompson; Mr. F. W. E. Spies (Holland); Mr. J. Shaw; Dr. H. S. Stannus; Master of the Worshipful Company, Major R. Miles; Dr. A. B. Everest; Mr. J. Cameron, Senr.; Sir George Briggs; Mr. N. P. Newman, J.P.; Mr. F. Webster, Mr. J. Goffart (Belgium); Mr. R. J. MacDonald; Mr. J. T. Goodwin; Mr. M. M. Hallett, M.Sc.; Mr. W. T. Stewart; Mr. C. H. Kain, F.I.M.; Mr. S. H. Russell; Councillor A. V. Sully, M.C., J.P., F.C.A.; Mr. W. R. Marsland; Mr. Barrington Hooper, C.B.E.; Mr. V. C. Faulkner, F.R.S.A.; Mr. J. W. Gardom; Mr. S. N. Clift; Mr. G. L. Bailey, C.B.E., M.Sc.; Dr. J. G. Pearce, O.B.E.; Mr. K. Marshall; Mr. D. H. Wood; Mr. P. H. Wilson, O.B.E.; Mr. R. Cherry Paterson; Mr. B. Keeling; Mr. R. B. Templeton; Mr. J. J. Sheehan, B.Sc.; Mr. C. Gresty; and Dr. C. J. Dadswell.

PROTECTIVE FOOTWEAR SERVICE, LIMITED, of Kingswood, Bristol, have placed on the market a pleasing design of fully-protective shoes for women workers. It is stated that the toe-cap will withstand a 40 ft.-lb. dropped weight.

MUREX WELDING PROCESSES, LIMITED, Hertford Road, Waltham Cross, Herts, announce the introduction of zirconiated-tungsten electrodes for use in the argon arc-welding process. These electrodes have the important advantage of greater resistance to contamination than the pure tungsten and thoriated-tungsten electrodes which have hitherto been generally used in this welding process.

This account describes the plant and practice at Castings, Limited, of Walsall, Staffordshire, a firm which, over the years, has built up a reputation for quality malleable castings for a variety of industries. The main product is blackheart, annealed by a combination of graphitization and decarburization techniques, its properties—maximum machinability, plus good tensile strength, elongation, bend value, etc.—being balanced to give a desirable all-round material. Similarly, the melting plant is regulated in its modus operandi *to give both the composition required and in quantity and frequency to suit the foundry operations. Again, foundry output is in equilibrium with annealing, dressing, and despatch requirements. This state of affairs, too, is propagated in the utilization of labour, as it is hoped to demonstrate in the account. Thus, in summation the claim of the firm to represent a balanced foundry in many phases is well substantiated.*

General Scheme

The malleable iron foundry of Castings, Limited, being situate in Walsall itself means that it is in the traditional centre of the industry in this country—an area where, since Domesday times, the making of saddlery and harness led to buckle and other small castings manufacture, and then naturally to whiteheart malleable production as soon as the process was developed. The foundry is situate in the town itself and the premises now occupy the whole of the site available, that is, there is no room for expansion. In turn, this means there is great necessity for turning into account every square foot of floor space and organizing compact and efficient production. For example, one of the major reasons why pelletted pitch is adopted instead of coal-dust in the sand is because it is easier to stock in limited quantities, it forms a simpler addition to the sand and greater control of the moulding properties can be instituted. A high degree of technical control is essential at the foundry, with all operations—melting, moulding, pouring, cleaning, annealing, etc.—all neatly dovetailed to fill the 24-hr. day and every inch of room available.

The scheme of operations and allocation of responsibility is shown in Fig. 1, and Figs. 2 to 10 convey a good idea of the plant and layout. Briefly, the site occupies 30,000 sq. ft. and the type of work might be termed mechanized jobbing to cater for the output from 12 moulding machines arranged in six pairs. The moulds are "banked" on gravity roller tracks, which method suits the batch nature of metal production from a battery of three rotary, oil-fired furnaces. The total personnel is fewer than 100 and production averages 35 tons of finished castings per week, consisting of roughly 100,000 items, the major number being only ounces in weight, up to a maximum of 70 lb. per piece. About 50 pattern changes per day are involved; Fig. 12 shows typical castings produced.

Inasmuch as the moulding operations control the melting practice, it might be most logical in this account to deal with those first. Another quite usual way would be to deal from a processing angle, from raw-material to dispatch deck. However, in this description it is assumed that readers are already cognisant of the rudiments of malleable-castings production and, following a listing of the plant—to be considered in relation to the layout and illustrations reproduced—emphasis is to be placed on quality control and its bearing on the integration of processing.

PLANT AND PROCESS SUMMARY

Melting and Metal Distribution

As already mentioned, melting is carried out in rotary furnaces. These are pretty much of the firm's own design and their method of operation has been fully described and illustrated elsewhere,*

* "Oil-fired Rotary Furnaces," by W. D. Bullows (a director of Castings Limited), Proc., Conference on Malleable Iron, organized by the British Cast Iron Research Association, March, 1951.

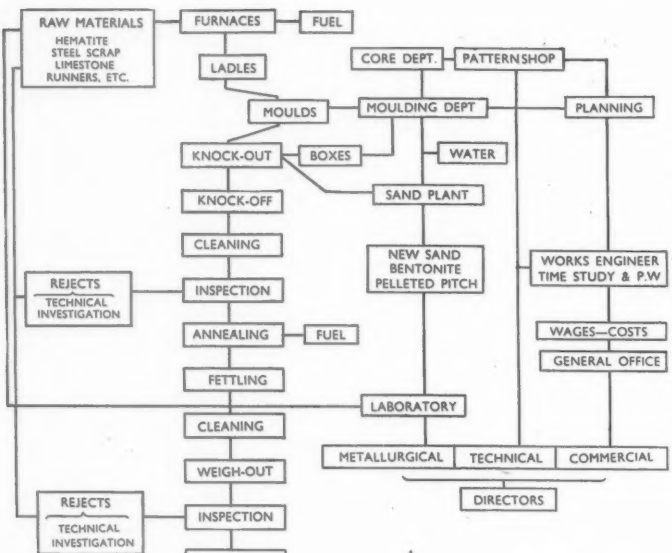


FIG. 1.—*Flow diagram of production methods at the foundry of Castings, Limited, Walsall.*

Figs. 3 and 4 and Table I being reproduced from this source, and Figs. 5, 6, and 7 also illustrating melting plant and practice. Two of the three furnaces, which are creosote-pitch fired and have a nominal capacity of three tons each, are used daily. This permits of six melts per day, three from each furnace alternately, there being 1½ hours between the start of each tap. Molten metal for pouring is collected in 400-lb. capacity drum-type ladles carried from a monorail running the length of the bank-conveyor tracks. At the end of these conveyors the metal is transferred to 112-lb. single-handed shank ladles carried from light monorails running the length of each conveyor bank (see Fig. 8).

Mou'ding

The six pairs of jolt-squeeze moulding machines, (Fig. 9), furnished by British Mou!ding Machine Company, Limited, have proved well suited to the type of work undertaken. Three sizes of box parts are worked, *viz.*, 12 by 16 by 4 in. magnesium-alloy boxes on the main conveyor line; 20 by 16 in. and 24 by 12 in. steel boxes 5 in. or more in depth, used in conjunction with adaptor frames.

Patterns

Practically all the moulding is done from plated patterns and the company are justifiably proud of their patternplate system. In general, two systems are in use—split patterns mounted on cast-iron or aluminium plates, or where splitting is not feasible the patterns are embedded in Sorel cement (basically, magnesium-oxychloride). Developments projected would seem to envisage a changeover being made to pressure-cast matchplates with advantage. Wooden master patterns are purchased outside, usually with double contraction, and then pattern-plates to the firm's own design are prepared on the premises, incorporating a novel means of matching and limiting contraction difficulties.

Feeding and Yield

As is well known, castings in white iron (such as those habitually cast for malleable) have a high liquid and solidification shrinkage, and means have been developed on a logical basis at Castings, Limited, for combating this. Briefly, the methods involve the maintenance of a "hot-spot" in the "head," whence feeding to the cooler parts can proceed; single feeding knobs are preferred. Attention to gating and feeding has currently raised the yield over a 12 months' period by over four per cent.. Good castings now represent 43 to 44 per cent. of the weight of metal melted, and the theoretical casting to riser weight is 46 per cent. Home scrap, from all causes, is below 8.0 per cent. and the firm proudly claims that customers' return scrap over the last three years is but 2.7 castings per 1,000. These rejection figures cover *all* causes; *i.e.*, there are no castings thrown out and uncounted at the pouring stations or elsewhere.

Mould Transfer and Knock-out

Three gravity-roller conveyor tracks are provided for the storage of moulds from each pair of moulding machines—each track being 12 in. wide. The moulds are poured on the tracks and mould weights transferred from track to track and never lowered to the floor (Fig. 8). After pouring, there is segregation by transfer unit into jobs of a kind, the movement of the boxes to the knock-out being arranged on a power-driven chain conveyor by which they are raised to waist height at the discharge point. The knock-out itself is vibrated by Sinex units and fumes are taken away at the side (Fig. 10).

Castings with runners still attached are then placed for cooling in standard containers, size 24 in. square by 14 in. deep. The latter are arranged for transport about the further processing sections either by plain lift truck or a "Cleco" battery-type electric truck. Adjacent to the cooling area, runners and risers are knocked-off, using the three-container system—one container for the assembly, one for the castings and one for the runner and riser scrap. The latter is broken small at this point to facilitate subsequent hand charging of the rotary melting furnaces.

Barrel Cleaning

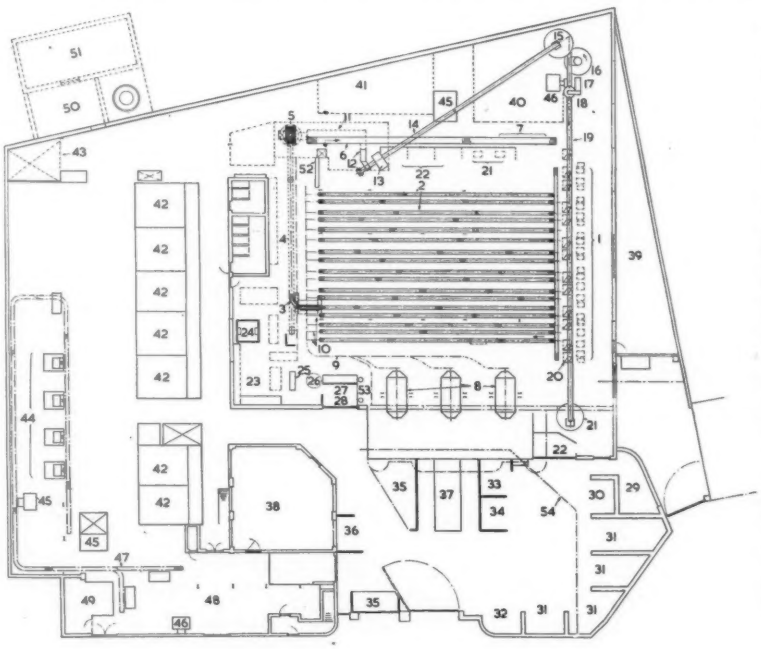
The castings then pass to an impeller-type, shot-blast barrel (Wheelabrator) which has been fitted with a novel power-hoisting control. This has a slow-tipping motion incorporated, so that castings tend to roll over each other into the barrel, a device which greatly reduces the possibility of breakage—it must be remembered that as-cast "malleable" is extremely brittle and the sections quite fragile. After cleaning, the castings are returned to the same container and then pass to the "hard" inspection section, where each one is handled individually. Afterwards, the batches are weighed (all weights being recorded in pound units only, throughout the works). At this point allocation is made of castings output for calculating payment to the moulders and a scrap record is compiled and analysed as to causatory features.

Work Simplification

A scheme of work simplification with mechanical aids has recently been applied at the Walsall foundry with much advantage. Before the adoption of the present system of mechanical aids described earlier, the moulders carried out all operations as individuals or pairs up to and including knocking castings from runners. Briefly, they: (1) made cope or drag mould, or both, shovelling backing sand from the floor; (2) laid cores; (3) closed moulds; (4) carried moulds to the floor (sometimes 20 ft. away from the machine); (5) placed weights; (6) collected metal from furnace in hand shanks; (7) poured moulds; (8) removed weights; (9) carried poured moulds back to the sand heap, dumped them and then extracted castings and runners; (10) re-conditioned backing sand with the aid of shovels and buckets of water; and (11) finally they knocked the runners from the castings.

Under this system, it was found that with many jobs a moulder could make more moulds than he could pour, so service was given him by providing additional labour for weight moving and box dumping, but no one liked that job. In brief, output was limited by physical capability. The economics, too, were bad—skilled men were being expected to include a navvy's job, under adverse conditions. (A view of the foundry showing this type of working, but taken after partial sand-system mechanization had been installed, is shown in Fig. 11). With the present system (Figs. 8, 9 10) a moulding-machine operator makes cope or drag only. Instead of shovelling sand from the floor, he pulls the lever releasing sand from overhead hopper. On completing a half mould, he takes a half turn and places drag half on the adjacent gravity conveyor, which is arranged at convenient height. Cores are then laid by core layers and the operator making the cope half closes on. Waste of energy and time in load carrying, bending and walking are reduced to a minimum. Moulds are pushed manually along the gravity track by a separate gang of men, who place weights—moving these from adjacent track—again at convenient distances and heights. This gang pours the moulds; the men

FIG. 2.—*General layout plan of the malleable foundry of Castings, Limited.*



KEY: (1) moulding machines, with overhead hoppers; (2) "bank" mould storage, comprising 17 lines of gravity conveyor; (3) transfer unit to knock-out chain; (4) knock-out chain; (5) knock-out grid, with hopper below; (6) box-return conveyor; (7) box-cleaning department; (8) three rotary furnaces; (9) overhead runways for service ladles; (10) 17 overhead pouring runways; (11) rotary sand barrel; (12) elevator; (13) magnetic separator; (14) belt conveyor; (15) storage hopper; (16) continuous sand mill; (17) elevator; (18) disintegrator; (19) overhead conveyor belt for sand; (20) overhead sand hoppers; (21) facing-sand mill; (22) red sand; (23) core-shop; (24) core stove; (25) core-blowers; (26) core-mixer; (27) sea-sand store; (28) creosote-pitch tank (overhead); (29) tip for waste; (30) steel scrap; (31) pig-iron; (32) scaling; (33) coke-dust; (34) limestone; (35) hard coal; (36) coke; (37) cycle shed; (38) pattern shop; (39) pattern stores; (40) inspection department; (41) knock-off department; (42) annealing ovens; (43) iron ore; (44) dressing department; (45) Wheelabrators; (46) weighing machines; (47) overhead conveyor; (48) warehouse and despatch department; (49) planning office; (50) maintenance department; (51) power-house, etc.; (52) ladle drying (small) (53) service-ladle drying; (54) overhead runway to furnaces.

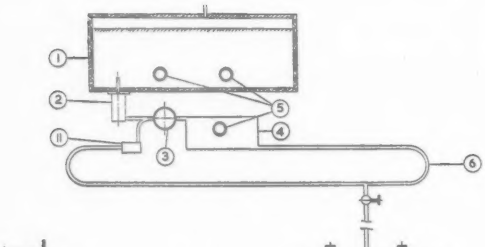


FIG. 3.—*Diagram of the fuel-control system for one of the melting furnaces.*

KEY: (1) storage tank; (2) filter; (3) circulating pump; (4) preheater tank; (5) heater; (6) ring main; (7) filter; (8) flow meter; (9) meter pump; (10) burner; (11) pressure valve; (12) primary air; (13) secondary air; (14) thermocouple; (15) thermostat; and (16) hot plate.

pushing and pouring only—not having to carry hot or heavy loads. After pouring, weights are again moved to the adjacent track, where moulds are ready to receive them. Poured moulds are pushed, as many as 20 at a time, to the knock-out conveyor, which delivers one mould at a time on to the vibrating grid at desk height. Sand falls through the grid, so that the knock-out men have only to remove the box parts and boards, place these on return conveyor and rake castings and runners into a stillage for removal to the cooling station.

As a result of this rationalization of production, fumes are reduced to a minimum and the foundry becomes a better place to work in. This work simplification was achieved by breaking-down the duties previously carried out by a skilled moulder into six sections, and this, with the provision also of production control, resulted in greater output of over 50 per cent. for the same man/hours and floor space.

Annealing

After the recording of production weights following " hard " inspection, the castings are transferred, also in stillages, to the annealing department. Here, the method still found economical for the type of work undertaken is pack annealing in stationary coal-fired ovens. The company has considered both the adoption of gas- or electric-furnace annealing, but, so far, the high capital outlay involved has not seemed justified by sufficient advantage in quality, speed or process economy. However, the change-over to the gaseous annealing method is not ruled out from the programme of future development.

On each stillage of castings arriving at the annealing department there is recorded the order number and quantity. Annealing cans are filled inside the

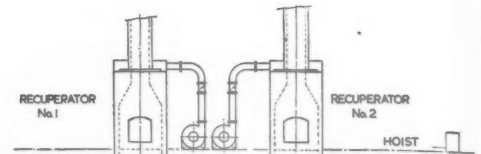


FIG. 4.—*Elevation of the group of three melting furnaces, showing two in use and one being re-lined. Note the alternative positions of exhaust elbows.*

oven. In packing the cans, which are 13 in. dia. by 11 in. high and provided with false bottoms, castings are mixed to give maximum packing density. The annealing staff are set a target or stint of cans to be filled or emptied per day and their allotted quota being completed are free to depart. Hematite ore is used for packing, in the ratio of one part of new ore to five parts old. The ore size is described as " 70 kibble." When it comes to emptying cans after cooling, the men engaged on this work are supplied with the batch tickets of the castings which were loaded into a given furnace and they re-allocate the annealed castings according to the tickets.

Castings are subsequently ground at the fettling section, to which the pans are taken on stillages. Double-ended grinders and other conventional equipment is used for removing runner and riser stubs, " flash " joint lines, etc. An unusual feature here is the method of payment which is based on the average amount of metal removed by grinding, *i.e.*, usually on the area and depth of runner to be ground off, and " flash " is assessed per batch. More will be said about this later. Castings are next cleaned in an air-less shot-blast plant, inspected and re-loaded on a gravity conveyor buffer track leading to the despatch department. Here all batches are weighed and counted and finally bagged ready for sending away. Incentive schemes are also in operation in this department and these, too, will be dealt with later.

QUALITY CONTROL

Having briefly surveyed the routing and main production operations at Castings, Limited, and conveyed, it is hoped, an idea of the flow cycle, it is next proposed to deal in some detail with the means adopted at each location to institute rigorous quality control—for metal production, annealing and sand systems.

Metal Production

The basic materials charged into the furnaces are hematite, pig-iron, steel scrap, return scrap

(runners, feeders, etc.), limestone, coke dust, creosote pitch and air, all of which are very accurately controlled by weight or volume. Excluding return scrap, which varies between 50 and 60 per cent. of the basic charge, according to the yield and average section of castings, the consumable charge consists of an average of 78 per cent. hematite and 22 per cent. steel scrap. Limestone is added up to 1½ per cent. and coke dust to 3 per cent. of the basic charge.

Each furnace has a positive-displacement meter pump of the firm's own design and manufacture, which is essential for precise and predictable oil-fuel control. Correct atomization of the creosote pitch is obtained by the use of Urquhart-type oil burners, using a separate compressor working at 10-lb. per sq. in. for the cold primary air, and thermostatic control of the creosote pitch temperature to ensure correct viscosity. The secondary air, preheated to 500 deg. C. in recuperators (operating at a maximum temperature of 875 deg. C.) is regulated by Bristol air-flow controllers. These controllers operate through the differential pressure across an orifice plate situated in the intake line to a fan. The total combustion air is maintained at 150 cub. ft. of air per lb. of creosote pitch, which is consumed at between 400 and 450 lb. per hour. The instruments and controls are operated and set by the laboratory staff and not by the furnacemen. Such a degree of instrumentation and procedure (which eliminates as far as possible the frailties introduced by the human element) is most necessary to ensure control of composition at temperatures and holding periods in the superheating range. Average metal temperatures at tapping are between 1,460 and 1,500 deg. C., and can be easily exceeded, in fact, using normal fuel and air ratios, metal temperature will increase at 5 deg. C. per min. at the average tapping temperature quoted. The adoption of these relatively high temperatures is so as to offset temperature losses obtained in the double transfer of metal from furnace to service ladles and then to pouring ladles.

Metallurgical control is, therefore, statistical, and based on the immediate past performances of each furnace as follows:— Each individual charge is calculated, by using the oxidation losses of the previous seven melts, ignoring the highest and lowest of these, and using the average of the remaining five to obtain the desired composition. This charge is then accurately weighed, using a suspended, dial-type weighing machine calibrated in pounds up to 2,000 lb. When tapped, some 30 to 40 mins. are needed to discharge the three tons, owing to the use of a minimum number of pouring operators—the reasons for which are given elsewhere, and this further emphasizes the need for the high degree of control mentioned so as to ensure that composition is held constant during this period.

Composition

Composition of the white cast iron is dictated by the fact that the bulk of the castings which are produced to BSS.310 (blackheart), are of light and medium section, requiring metal fluidity of a high order in order to minimize foundry scrap due to mis-running. The average carbon content desired is around 3.10 per cent., with a silicon content of 0.60 per cent. The fluidity of such metal when cast at 1,420 deg. C. (and assessed by the B.C.I.R.A. method established by Evans) is 16 in., as compared with a length of 8 in. under otherwise identical conditions yet with a composition of total carbon 2.4 and silicon 1.0 per cent.—one which is more common for heavy- and medium-section blackheart castings.

It has already been established that *control* is arranged on the basis of history and statistics and melting time is similarly predicted and the time of tapping set to within plus or minus 5 min. The temperature of the second service ladle from each melt

FIG. 5.—*Two of the battery of three creosote-pitch-fired rotary melting furnaces.*

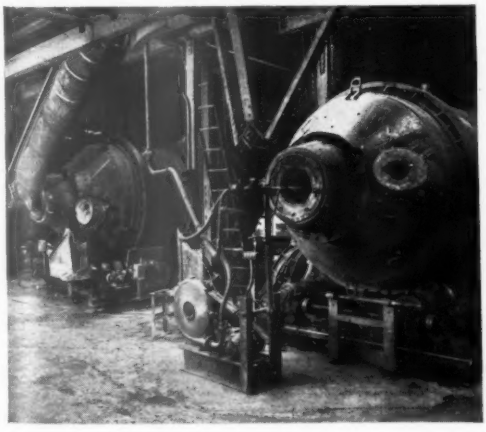


FIG. 6.—*Control panel for operation of the melting furnaces.*

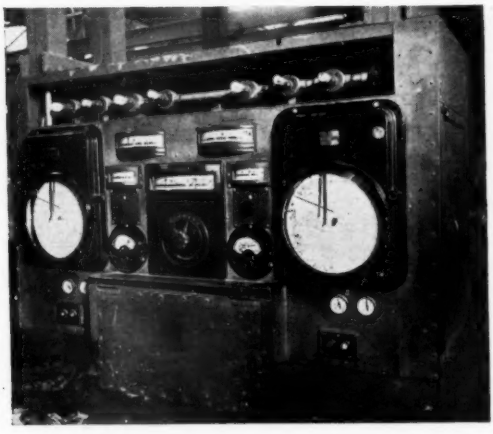


FIG. 7.—*Metal being tapped from one of the rotary furnaces and collected in a 400-lb. ladle carried from a monorail.*

is obtained by an immersion thermocouple and indicator, in the presence of both furnacemen and foundry foreman; it is recorded, and forms part of the statistical pattern for predicting the melting time of future melts. Statistics for such rotary-furnace melting, previously published in the paper by W. D. Bullows at the B.C.I.R.A. malleable conference are set out in Table I:—

Castings of heavy section, which would be liable to the precipitation of primary graphite if the standard composition were used, are made on the last melt of the day, with the composition modified in respect of having a lower-carbon content and equivalent silicon content. Such castings can then remain overnight on the gravity mould tracks for cooling. Later, they are carefully examined by the laboratory staff at the knock-off section, prior to cleaning and inspection, and are ruthlessly scrapped if traces of primary graphite are visible in the ingate areas.

Each melt carries a cast number and, irrespective of castings sold on a physical-test-inspection basis, at least three castings from each melt carry an identification cast number. Test-bars are cast at regular intervals, and, of course, when physical inspection is demanded for certain castings. Each melt is analysed in duplicate for carbon, silicon, manganese, and sulphur, phosphorus being checked at regular intervals. As a matter of interest, it has been found that the residual gases in the white iron are oxygen 5 to 20, nitrogen 55 to 60, and hydrogen 0.8 to 1.6 parts per million.

Annealing Control

Because of the initial high-carbon content of the white cast iron, *i.e.*, around 3.0 per cent., it has been found that if such iron is annealed according to conventional blackheart practice in an inert or non-decarburizing atmosphere, then tensile strengths and bend values are slightly below those specified for BSS.310 grade 2, which is the specification most commonly worked to. Therefore, annealing at

TABLE I.—*Rotary-furnace Melting Data for Malleable Castings.*

	Typical day's melting before air and oil control; flame judged by eye.				Present practice, with positive air and oil control.				Possible practice if very low oxidation losses are required.			
Cask number	1	2	3	4	1	2	3	4	1	2	3	4
Lining	130	131	132	133	31	32	33	34	157	158	159	160
Metal melted (cwt.)	46	54	50	42	52	56	52	52	40	50	46	42
Fuel flow (gall. per hr.)	42.0				40.0				44.0			
Cub. ft. air per gall. oil	Not known				151	149	149	152	130	129	132	130
Melting time (hr. min.)	2–20	2–10	1–55	1–40	2–19	2–11	2–0	1–43	2–10	2–10	1–55	1–43
Difference between calculated and actual analysis (per cent.) T.C.	−0 57	−0.48	−0.40	−0.32	−0.26	−0.19	−0.10	−0.02	−0.03	+0.06	+0.05	+0.11
ditto Si	−0.33	−0.30	−0.39	−0.40	−0.18	−0.13	−0.09	−0.09	−0.11	−0.09	−0.07	−0.06
ditto Mn	−0.37	−0.39	−0.30	−0.35	−0.11	−0.13	−0.12	−0.11	−0.11	−0.13	−0.12	−0.11
Maximum recuperator temperature (deg. C.)	Approx. 950				700	705	690	690	800	870	890	900
Maximum air temperature (deg. C.)	Approx. 250				370	415	425	405	440	490	540	550
Fe. content of slag (per cent.)	22	18	15	14	6.8	5.3	5.3	4.5	4.4	4.1	2.8	2.4
Fuel oil per ton melted (gall.)	Not known				36.0	31.1	30.6	26.5	47.6	38.0	36.6	36.0
Temperature of metal (deg. C.)	Not known				1,490	1,480	1,485	1,520	1,470	1,480	1,460	1,500

Refractories (furnace) .. .. 60 lb. per ton metal melted
Refractories (exhaust elbow) .. .. 27 lb. per ton metal melted
Power (kwh) .. .. 21.5 lb. per ton metal melted
Man-hours:—
Collecting and weighing charge and melting, maintenance (refractory) and mechanical maintenance 2.8 per ton metal melted

Castings Limited is a balanced process ranging between the decarburization necessary to reduce the high-carbon content to improve physical properties, and graphitization to achieve a completely ferrite/graphite structure, free from the pearlitic rim or "picture-frame" defect.

The annealing ovens are of the firm's own design and are all coal-fired except one which, experimentally, is oil-fired. All ovens are well insulated, using hot-face insulation material or alternatively, firebrick with low-temperature insulation behind it. There is a preference for the latter, for this type of oven rises to temperatures rather more slowly and thereby better distribution of graphite nodules is produced in the material.

As mentioned, the castings are packed and well consolidated in a mixture of old and new hematite ore, in relatively small white-iron annealing cans. Such a practice completely eliminates distortion and no straighteners or blacksmiths are employed. From the economic angle, the use of packing and containers appears from recent publications to be obsolescent. However, it may be pertinent to state that if packing and containers are not used then electricity or radiant tube-heating must be employed and electricity costs five times as much as oil fuel. On the other hand, the mass of work to be heated—cans—packing, etc., is approximately three times that of the mass involved in the gaseous process.

The cans are packed and emptied *in situ* and each oven has a thermocouple in both back and front walls, connected to a recording pyrometer, on which the desired annealing temperature is marked.

Reference has already been made to the provision in the foundry of castings identified with the cast number, and a stock of these is kept in the laboratory. Some of these are scattered at random through an oven when filling for annealing and after processing these are tested to destruction by the laboratory staff, and the results carefully recorded.

In addition, three small test-cans, each containing three of the selected test castings are placed in the front of the oven in such a position as to be capable of easy withdrawal after intervals of approximately 24, 48 and 96 hours after the oven has reached temperature. These castings are broken and comparison made from their fractures or, if necessary, by microscope. By these methods it is possible to compare iron having known "annealability characteristics" with the new material and to adjust the time/temperature cycle to minimize differences of annealability which are sometimes found and which are seemingly not entirely related to composition.

The annealing cycle used consists of heating the castings over some 36 hours to a temperature of 1,000 deg. C. and then 72 hours slow cooling in stages from 1,000 to 900 deg. C., when the oven is allowed to soak and cool to 720 deg. C. At this stage it is held for a further 48 hours between 720 and 700 deg. C., before being allowed to cool to 600 deg. C. for opening. The product has a typical blackheart-type of fracture with a structure of ferrite and graphite. This structure has been described at length in papers by H. G. Hall, previously published in the JOURNAL.

Physical Properties

The results shown in Table II have been obtained recently in 12 test-bars from six consecutive melts, by an independent authority:—

TABLE II.—*Physical Test Results from 12 Bars representing six consecutive melts.*

	Ultimate tensile strength. tons per sq. in.	Elongation. per cent.	Bend. deg.
1	21.1	18.0	180
2	20.3	18.5	180
3	21.2	19.5	180
4	21.1	22.0	180
5	21.3	18.0	180
6	20.5	14.0	180
7	20.5	19.5	180
8	20.7	20.0	180
9	20.2	15.0	180
10	21.4	18.0	180
11	20.4	15.5	180
12	20.1	15.0	180
Average ..	20.7	17.75	180

Pearlitic and Weldable Grades

For customers desiring harder and tougher grades of castings, various grades of "pearlitic" malleable are made, having properties of up to 35 tons per sq. in. in tensile with 5 per cent. elongation. These are achieved either by a second heat-treatment of the standard metal or by the addition of a carbide stabilizer to the metal along with a normal anneal.

After much research and practical experimentation, the firm developed a special malleable which can be arc-welded. This grade has in fact been used with success for several years and is now finding an

FIG. 8.—*Pouring the moulds, lying on the roller-conveyor "banks," from monorail-suspended service ladles.*

FIG. 9.—*Line of moulding machines arranged back-to-back, in pairs, with sand hoppers above.*

increased market, particularly where fabrication "marrying" of cast and wrought components is desired.

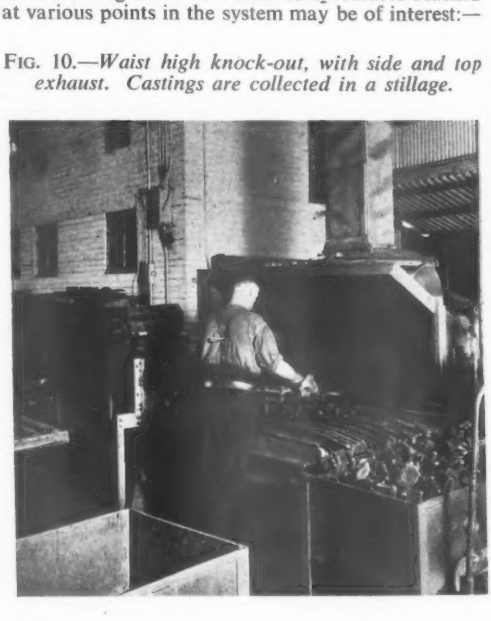
Sand Control

Moulding boxes are discharged (after being poured) on to a Sinex vibrated grid at waist height. The sand falls into a hopper of two-tons capacity having a rotary base-plate. It is subsequently ploughed off this plate into the open end of a rotary barrel. A pivoting flap on the outer periphery of the base-plate operates a solenoid type of water valve and this ensures that when sand is flowing, water enters a funnel leading to a pipe discharging into the mouth of the rotating barrel. The amount or volume of water is controlled manually by sight and feel of the sand being knocked out, this being merely a preliminary adjustment. The sand travels through the rotating barrel and drops through a screen at its end into the mouth of a bucket elevator which discharges it on to a supply belt leading to the main storage hopper of 12 tons capacity. A magnetic "Overband" separator is located on this belt near to the elevator. From the main storage hopper, sand passes at 15 tons per hour, through a continuous mill, where final adjustment of moisture is manually controlled From the mill, the system sand discharges into the mouth of a bucket elevator through a suspended-pin type of disintegrator, *via* a rubber tunnel or inverted funnel on to the supply belt leading to the moulders' hoppers. At the further end of this belt is a storage hopper arranged to feed a batch-type facing-sand mill.

Castings Limited, stress that a major requirement of the industry is a fully-automatic and foolproof system of moisture control in mechanized sand handling. Many experiments have been carried out at their own works—so far with little success. Moisture control is still, therefore, largely by feel, by sight and by check with the "Speedy" moisture tester.

The problem is further complicated by sand temperature variations—caused by batch dumping—and the following maximum sand temperatures reached at various points in the system may be of interest:—

FIG. 10.—*Waist high knock-out, with side and top exhaust. Castings are collected in a stillage.*



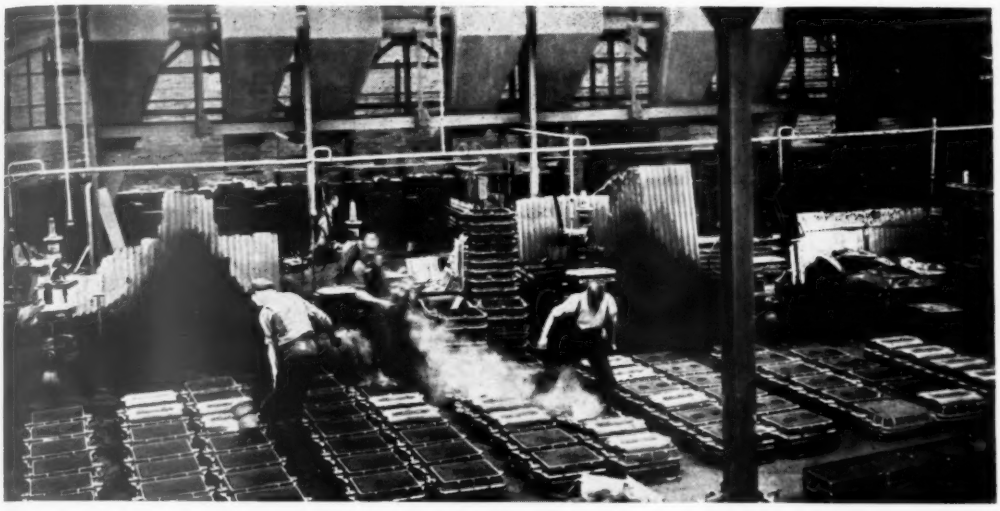


FIG. 11.—*General view before mechanization of mould storage was applied.*

	Temp. deg. C.
Knock-out hopper base-plate ..	120
Discharge from sand barrel ..	60
,, ,, main storage hopper	55
,, ,, continuous mill ..	50
,, ,, disintegrator ..	38

These conditions have so far determined the use of facing sand for the majority of the moulds made, but it is intended to develop the use of a unit sand as soon as possible for at least 60 per cent. of the firm's production.

The facing sand is naturally bonded and is based on a Stourbridge red sand—purchased in the milled and disintegrated condition—and additions of 10-13 per cent. of this are made to the system backing sand. Pelleted pitch is added according to the section and type of casting to be moulded and averages around 0.2 per cent. in the system sand. It is of interest to note that the percentage of red sand added to all sand in use is between 2.5 and 3.0 per cent. Wood-flour in amounts of up to 2.0 per cent. is added for special jobs which have been found to be prone to scabbing. Table III gives typical sand properties.

A fully-equipped sand laboratory is situated in the foundry itself, immediately adjacent to the continuous mill and moulders' service belt. Statistical control charts are made up daily from the routine test results, thus allowing a rapid and visual check of properties and trends. The hard-castings inspection section is also located adjacent to the sands laboratory and there is a useful liaison between both departments, which minimizes scrap due to sand defects.

TABLE III.—*Typical Sand Properties.*

	System, sand.	Light, facing.	Medium, facing.	Heavy, facing.
Moisture, per cent. ..	4.0 to 4.5	4.0 to 4.5	4.0 to 4.5	4.2 to 4.6
Green-strength (lb. per sq. in.)	6.5 to 6.0	7.5 to 7.0	7.8 to 7.3	8.0 to 7.5
Permeability number	38 to 43	33 to 38	30 to 35	28 to 33
Shatter	48 to 53	63 to 68	70 to 75	73 to 78

Coreshop

Core-drying is carried out in a continuous, vertical-type stove, charging and discharging from the same opening, and having a total time cycle of one hour, the temperature being maintained at 230 deg. C. This stove is fitted with a recirculation unit which has enabled a thermostatic control device of the firm's own design to be applied to coke firing, resulting in straight-line control, recorded on the chart, almost irrespective of hand firing or bed coke conditions. The scrubbing action of the recirculated gases permits close packing of cores on the trays without loss of consistent drying properties.

The main ingredients of the core-sand mixtures are Congleton silica sand, Stourbridge red, floor riddlings, cereal binder, core-oil and water. There are two main mixtures for coreblower and bench work, with a special mixture for filter and strainer cores. Mixing is carried out in a Fordath-type mixer, all materials being measured by weight or volume. Typical core-sand properties are as follow:—

	Core-blower.	Bench mixture.
Moisture, per cent.	1.6 to 1.3	3.0 to 2.7
Green-compression, (lb. per sq. in.) ..	1.6 to 1.3	3.4 to 3.0
Green-permeability number	75 to 70	70 to 65
Baked compression, (lb. per sq. in.) ..	1,000 to 900	900 to 800
Dry-permeability number	100 to 90	130 to 110

FIG. 12.—*Group of castings from the range made by Castings, Limited.*
Industries represented are: (*a*) and (*e*) agricultural; (*b*), (*f*) and (*i*) commercial vehicles; (*c*) gunsmiths; (*d*), (*g*), (*k*) and (*l*) general engineering, (*h*) motor-cycle; and (*j*) automobile.

The mixtures are clearly noted on a control board in front of the core stove and the laboratory test results are chalked in daily to enable the coreshop foreman to recognize and if necessary to correct his sand conditions.

The coreshop can be described as being of a truly jobbing nature, and although quantity production is achieved by using a Coleman horizontal-type and Redford vertical coreblowers—with drying shells where necessary—many intricate jobs are made by hand in wooden coreboxes. In these cores, it has been found that up to 8 per cent. of red sand will prevent sagging without seriously impairing the properties of the finished core. Resin-bonded sands do not appear to suit the many and varied types of job so successfully as do the cereal/oil bonded mixtures.

From these notes, it will be obvious that the works are provided with fully-equipped and adequately staffed chemical, physical and sand testing laboratories, the results from which are being applied at all stages of manufacture. There is also close liaison with the B.C.I.R.A., plus participation of members of the staff in the Institute of British Foundrymen and the American Foundrymen's Society, all of which helps to maintain this firm's proud boast of phenomenally low customer returns.

Incentive Payments

As already mentioned, payment in all departments of Castings Limited foundry is by results achieved, and separate schemes have been applied for each department. Where possible, these are on an individual basis but in a few cases a group system of bonus payment is used. The incentives are fully understood by the personnel and the reward is clearly apparent to them as they carry out their duties. Where a worker's effort to maintain continuity and work flow is dictated by a previous operation, he is paid accordingly. Each operator has a guaranteed minimum weekly wage, but it is expected that this should always be exceeded. Enforced waiting time due to contingencies outside an operator's control is paid for at an hourly rate. In some cases, an additional incentive is paid on the piecework earnings after a set target figure has been attained.

All wage earners are paid on an hourly-rate basis to facilitate the making of amendments, such as additional national-award or merit money. In general, their weekly wage is the (hourly rate) 44 plus (p.-w. earnings) plus (additional incentive for reaching target). The system as applied to the various classes of work is as follows:—

Moulding. The men work in pairs, one making the drag and the other the cope. If cores are used, these are put in by a core layer. Payment for each mould is based upon the size and number of individual operations required to make the mould (these individual operations have been time-and-motion studied and a list of standard times and prices computated for them). An additional incentive of 25 per cent. is made for all p.-w. earnings exceeding a certain sum per hour. For example, a weekly wage is made up of (hourly rate) 44 plus (p.-w. earnings) plus $\frac{\text{(p.-w. } - \text{ 3/-)}}{4}$.

Pouring. This includes weight moving and knock-

ing-out and is done on a group system. The earnings are based upon the weight of castings (less the scrap due to pouring) and the number of moulds handled. Here, an additional incentive of 50 per cent. is paid for all p.-w. earnings over 2/6d. an hour. Thus the weekly wage is (hourly rate) 44 plus (p.-w. earnings) plus $\frac{\text{(p.-w. — 2/6d.)}}{2}$.

Box Cleaning. This operation has been found necessary when using pitch-bonded sand and it includes the servicing of moulders with boxes and bottom boards. Payment here is based upon the number of boxes handled plus an hourly rate plus merit money.

Sand System. This work includes facing-sand preparation, sand distribution and re-conditioning and is paid for in a similar manner to box cleaning.

Inspection and Cleaning. This is a group system, payment being made upon the equivalent weight and number of castings handled (computated from the number of moulds made).

Knock-off. This is handled in a similar manner to inspection and cleaning.

Annealing. Including filling and emptying, this is a group system and payment is made according to the number of cans dealt with.

Dressing. This is a straight individual p.-w. system and is based upon the number of castings dressed and the size of the ingate or riser stub to be removed.

Warehouse. This, too, is a group system and includes cleaning and despatch. Payment is made upon the weight of castings cleaned, sorted and bagged, weighed and despatched.

Melting. This is a group system taking in furnacemen and those operating the service ladles and the wages are based upon the standard hourly rate plus a bonus dependent upon the weight of castings poured plus merit money according to seniority.

Coremaking. Men and women are employed in this department and payment is by a straight p.-w. system based upon the number of good cores made plus an hourly rate.

In addition to the foregoing, the chargehand of the moulding section and the corelayers are paid a standard wage plus a weekly bonus based on the earnings of the moulders.

Amenities.—There is both a works and staff canteen and hot lunches are cooked on the premises. These amenities are slowly but surely increasing in popularity and use. The works canteen has cream painted walls, with the lower sections in lime green. There is a piano and also dartboard, etc., and the Social Club runs a very successful darts team. Recently, the Club has been granted a licence which enables employees to entertain visitors after working hours, and many jolly evenings have been had. Other social activities include a works' trip yearly, a visit to the theatre, and a Christmas party. So far, space has not been found for the installation of shower-baths, etc., provision of which is shortly to be enforced. Site conditions are a real embarrassment here, but no doubt a solution will be found.

Conclusion and Acknowledgment

No claim is made that the foundry of Castings, Limited has everything that represents the last word in modernity, the walls are not tiled and no one would say there is much chromium plate or showroom elegance. Nevertheless, cleanliness and neatness are a feature of the whole works and it is clear that good-housekeeping is really believed to be worthwhile. There are irksome site restrictions both as to shape and size and the very nature of the production—a sort of mechanized jobbing—brings all sorts of complications in its train. However, it is thought that in the manufacture of that type of casting to the specifications laid down, under the conditions described and with plant and labour available an outstanding measure of balance has in fact been achieved. In like degree, wage earners and executives are well proportioned. There is that sound notion held by all that foundry innovations must stand up to a many-sided examination —not boom economy, but lean-time economy—before they can endure.

In conclusion, the writer records his thanks to the staff of the firm for assistance given in compiling this account of a very worthwhile undertaking.

Board Changes

MATHER & PLATT, LIMITED—Mr. Herbert Taylor has retired from the board.

FERRANTI, LIMITED—Mr. Sebastian Ziani de Ferranti has been appointed a director.

G. HOPKINS & SONS, LIMITED—Mr. John Lorimer Harvey has been appointed an additional director.

STAVELEY COAL & IRON COMPANY, LIMITED—Mr. M. Froggatt, secretary, has been elected a director.

MIDLAND EMPLOYERS' MUTUAL ASSURANCE, LIMITED —Mr. H. B. Yates has been appointed a director of the company with effect from March 16.

P. & W. MACLELLAN, LIMITED, engineers and iron founders—Mr. James R. Thomson and Mr. R. G. S. MacLellan have been appointed directors.

ALEXANDER STEPHEN & SONS, LIMITED—Dr. A. S. MacLellan and Mr. G. R. Grange are to retire from the board at the end of this month.

BOWMAKER (PLANT), LIMITED—Mr. L. K. Jarvis and Mr. John Adamson have resigned from the board, and Mr. C. J. Lake and Mr. R. A. Robertson have been appointed directors.

PURIMACHOS, LIMITED, manufacturers of refractory cements—Mr. A. B. Blunsden, M.I.CHEM.E., A.R.I.C., and Mr. J. R. James, B.A., F.R.G.S., have recently been appointed to the Board of Directors.

CAPPER PASS & SON, LIMITED—Mr. J. F. A. Roche and Mr. E. H. Jones have been appointed joint managing directors and Lt.-Col. S. G. C. MacWatters has been appointed to the vacant seat on the Board.

BRITISH CHROME & CHEMICALS, LIMITED—Mr. A. C. J. Burningham has been appointed an additional director on the main board and deputy managing director. Mr. J. Laurie and Mr. T. Williams have been appointed special directors and Mr. Carlton Reynolds has been appointed secretary.

Notes from the Branches

TEES-SIDE APPRENTICE COMPETITION

At the annual general meeting of the Tees-side branch of the Institute of British Foundrymen, held on April 2, the prize-winners in the branch apprentice competition received their awards from Mr. R. Miles, chairman and managing director of Head, Wrightson & Company, Limited, and a past-president of the Institute. The competition was divided into four sections and these are given below, together with the first-prize winners:—*Patternmaking section:* Mr. A. Rawlins (Darlington Railway Plant & Foundry Company, Limited); *cast-iron moulding section:* Mr. J. Ritchie (Ashmore, Benson, Pease & Company, Limited); *steel-moulding section:* Mr. C. Cummings (Head, Wrightson & Company, Limited); and *non-ferrous moulding section:* Mr. G. Vickers (Daralum Castings, Limited).

In addition to a monetary first prize of three guineas, a second of one guinea, and a third and fourth of half-a-guinea, each prize-winner received a certificate as a permanent record of his success. In the event it so happened, in view of the rather small number of entrants for the non-ferrous moulding section, the second prize in this case was half-a-guinea and one guinea prize money was taken from this section and re-allocated in equal proportions to the patternmaking and cast-iron moulding sections to make four prizes. In addition to these prizes, ten copies of the Institute's "Atlas of Defects in Castings" were distributed to the first ten competitors in the cast-iron moulding section. These had been donated by the judge in that section.

Competition Organization

The patternmaking competition took place on February 10, each competitor being issued with a drawing and instructions, including the rules of the competition. Thirty-eight entries were received in this section from 21 firms. As far as the moulding section was concerned, fifteen standard patterns were made and circulated to competitors' foundries by district and entries were received as follows:—

Steel: 27 entries from 3 firms; *cast iron:* 38 entries from 11 firms; and *non-ferrous:* 7 entries from 4 firms.

Competitors in all cases produced their entry in their own place of work under the supervision of their usual staff. The apprentice competition committee issued comprehensive notes for guidance of supervisors, which were strictly adhered to. All entries were sent to a central point where judging took place on March 17. The judges were drawn from outside the branch's area and the following kindly acted in this capacity:—For patternmaking, Mr. L. Brown; for steel moulding, Dr. C. J. Dadswell; for cast-iron moulding, Mr. G. Nicholls; and for non-ferrous moulds, Mr. F. Hudson. As far as possible, all entries were examined in detail and a number of marks allocated on the basis of: (1) method of moulding; (2) gating; (3) risers and feeders; (4) yield; (5) general appearance and standard of surface finish; (6) soundness; and (7) time. The judges also submitted their general comments on the quality of the work put in front of them. The marks obtained by each apprentice, together with a copy of the judge's comments, are being circulated to each of the competitors' firms.

It is considered that the response and results of the competition have been very encouraging and the branch Council hope to organize another one next year. The competition committee appointed by the Tees-side branch committtoe to be responsible for planning the event comprised Mr. A. P. Riley (chairman); Mr. C. H. Wilson (secretary); Mr. J. Vickers; Mr. L. Johnson; and Mr. G. Stanley.

East Midlands

Between 160 and 170 members of the East Midlands branch visited Stanton Ironworks and toured the Erewash Foundry, and the training centre. Mr. H. Pinchin, manager of the Erewash Foundry, is president of the East Midlands branch of the Institute. Included in members of the party were the senior vice-president of the Institute, Mr. D. W. Berridge, of Leicester; the junior vice-president, Mr. H. P. Miller, manager of Stanton Holwell Foundry; and the secretary, Mr. S. A. Horton, of Ley's Malleable Castings Company, Limited, Derby.

Bristol and West of England

The branch annual dinner took place at the Grand Hotel, Bristol, on February 27, and was attended by the president of the Institute and Mrs. Longden, Mr. T. Makemson, M.B.E., Mr. G. MacKinlay, president, Mr. A. S. Wall, hon. secretary, respectively, of the Wales and Monmouth branch, Mrs. Wall, and members and friends of the Bristol branch.

In proposing the toast of "The Institute of British Foundrymen," MR. H. V. HEATH gave a *résumé* of the work which had been done, and is still being done, by the many sections of the Institute, not only in the interest of members, but also on behalf of the foundry industry as a whole, quoting the work which the various bodies were doing for education amongst young foundry workers—work inspired and guided by the Institute. Coupling the name of the national president, Mr. E. Longden, with that of the Institute, Mr. Heath referred to the respect with which Mr. Longden was held in the foundry world, and to the many papers and publications on foundry subjects, of which he was the author.

Proposing the toast of the "Bristol and West of England Branch," MR. MAKEMSON outlined the history of the branch, from the early days, when it was a section of the Wales and Monmouth branch, to its status as a full branch. He referred to the work done on behalf of the branch by the branch presidents and added that very few of them were really west-country men, but that they had settled in that part of the country and were a real asset to the Institute's activities. Mr. Makemson also referred to the excellent work done on behalf of the branch in the past by Mr. A. Hares, and added that the present honorary secretary, Mr. G. W. Brown, was settling down well with his new responsibilities.

Replying on behalf of the branch, MR. L. BUCKLEY, branch president, thanked Mr. Makemson for what had been said about the branch officers. The Bristol and West of England branch area was a large one, said Mr. Buckley, but it contained a hard core of enthusiastic members who had the interest of the Institute at heart. MR. D. A. RICHARDS, in proposing the toast of the "Visitors and Ladies," said that the branch was honoured to have Mr. and Mrs. Longden present, since all appreciated the many onerous duties that the president was called upon to perform during a year of office, and their presence indicated genuine interest in the welfare of the branches.

MR. G. MACKINLAY replied on behalf of the visitors, while MRS. LONGDEN replied for the ladies. The dinner was followed by a social evening organized by Mr. Hayward, Mr. W. Hares, Mr. Heath, and Mr. Richards.

New Equipment

"Anson" Shell-moulding Machine

Anson Industries, of Church Street, Castleford, have provided the following description of their Mark I shell-moulding machine, which is shown in Fig. 1.

In principle the equipment comprises a two-oven unit from which one operator can produce 25 shells per hour from each oven. It is designed to handle a wide range of castings varying from 1 in. to 13 in. overall, and up to 10 in. deep. Room for cores to a depth of 4 in. can be incorporated on the patternplate. The ovens, which are gas-fired, are each fitted with a gas-pressure regulator, thermostat, and thermometer graduated in degrees centigrade. The thermostat holds the temperature to within 10 deg. C., and can be set to give a curing time of less than one minute if required. The automatic control of the ovens gives maximum efficiency with minimum running costs. Hand-operated oven doors are fitted, with balance weights and roller guides.

A centrally placed dump box has its point of balance arranged for quick and easy turnover, and a heat-resisting seal fitted round the top edge of the box prevents resin build-up. Two clamping handles hold the patternplates in position during investment. Patternplates are so designed as to slide freely on conveyor rails fitted between the dump box and both ovens. Special lugs are fitted to each plate and provide a fulcrum for the easy turning-over of the hot plate on to the dump box. Angle pieces are fitted around the edges of the patternplate to ensure complete sealing and eliminate "peel back." At no stage is it necessary for the operator to handle the full weight of the pattern. This machine is fitted with an ejector station adjacent to each oven. Both stations are fitted with a patented special adjustment mechanism to allow for 3-in. and 5-in. ejector pins. Shells can be lifted from 1 in. to 3 in. clear of the patternplate. The ejector plates themselves have been designed to eliminate the distortion of shells during ejecion.

Sand-Reclamation Unit

A reclamation unit has been produced by the firm for the purpose of dealing with the disposal problems of used moulds, and also as an economy measure. It is of robust construction, having a 10 s.w.g. steel body mounted on 4-in. by 2-in. rolled-steel channel legs. In use, the unit is filled with used moulds, which are then set alight by inserting a gas poker in the apertures provided. When the moulds are burning freely (say after five minutes), the gas poker is removed and sand continues to flow freely from the outlet at the bottom of the unit. Further spent shell moulds should be added periodically as required.

Conveyor-belt Guide Unit

One of the major problems in operating a belt-conveying system is the belt "riding" the idlers. This often allows it to contact obstructions, which not only gives rise to undue wear on the edges, but creates a fire hazard due to excess friction. To overcome this, Mr. D. Krohn Holm, in conjunction with the American Knapp Mills, Inc., has designed a new type of guide based on the hyperbolic principle.

The device (Fig. 2), designated the "guidler" on account of serving as an idler as well as a guide, is claimed to return the belt to its proper alignment without injury, and can also be used to control a belt within narrow distances of movement. When properly installed at a 30-deg. angle, the "guidler" presents a revolving hyperbolic face to the bolt edge. The importance of this combination of motion and design is that the force of the impact is thus distributed over a relatively long, flat surface. It also moves along its axis and thus follows the vertical movements of the belt edge and controls

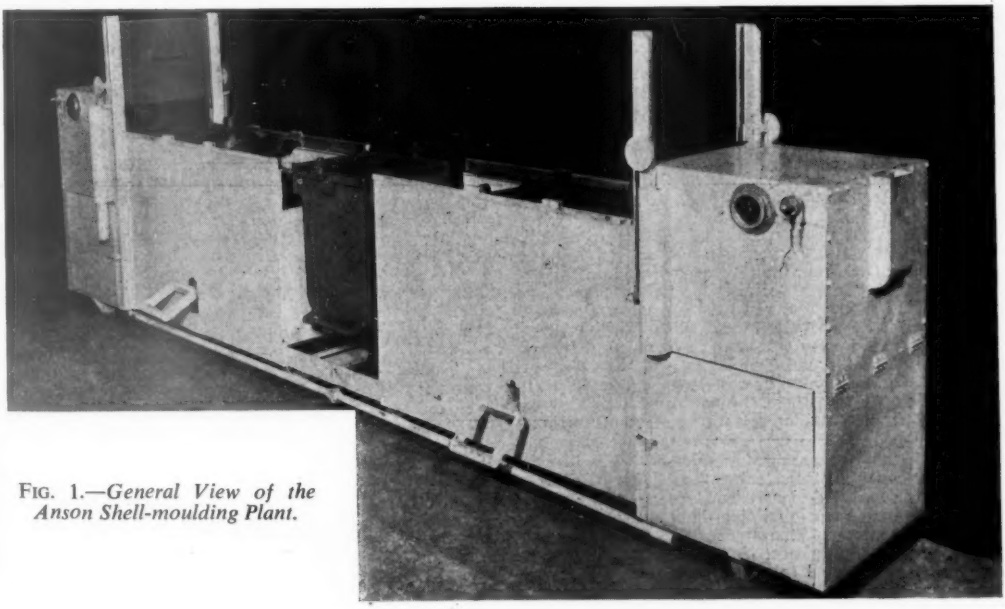


FIG. 1.—*General View of the Anson Shell-moulding Plant.*

FIG. 2.—*Specimen of "Guidler."*

it while rising. Several trial installations have been made in America and are proving satisfactory.

House Organs

Albion Works Bulletin, Vol. 8, No. 1 (March). Issued by John Harper & Company, Limited, Albion Works, Willenhall.

This issue appears—as is appropriate in the spring—in a new jacket, for which colour-printing has been used. Moreover this splash of colour has permeated the booklet as headings to real advantage. The Joint Production Council congratulated Lt.-Col. David Henry Lewis on the award of the M.B.E. (Military Division). In this issue there is a very readable article on fire prevention and from it, it would seem notices reading "No naked lights" would be preferable to those bearing the words "No smoking."

The Stantonian, February issue. Published by the Stanton Ironworks Company Limited, near Nottingham.

The cover shows a picture of Stapleford Parish Church, which would be very pleasing if only the spire could be removed from the tower. It is an exceedingly interesting building historically and is fortunate in possessing very complete records dating back to 1635. This issue carries a tribute by Mr. J. N. Derbyshire of the life and work of the late Mr. E. J. Fox, a former chairman of the Stanton Company.

Now that the spinning of cast-iron pipes is 30 years old, it is fitting that there should be included a long illustrated article detailing something of its history and its present position.

THE Parliamentary Secretary to the Ministry of Works stated that detailed designs of the testing tank and its equipment for the shipbuilding industry, which were elaborate because of the need for a high degree of accuracy, were now almost complete. Construction at Feltham was expected to start in October and it was hoped to complete the work in 1958.

British Standards Institution

The B.S.I. *Information Sheet* for March lists, among *New Standards,* B.S. 2091:1954, Canister respirators ("gas masks") and dust respirators ("dust masks"), and B.S. 2092:1954, Industrial eye-protectors for operations other than welding (both 4s.); B.S. 2094:1954, Glossary of terms relating to iron and steel: Part 1, general metallurgical heat-treatment and testing terms (6s.); Part 2, steelmaking (2s. 6d.), and Part 3, hot-rolled steel products (excluding sheet, strip and tubes) (2s. 6d.). This last named defines terms commonly used in the iron and steel industry. The definitions are essentially technical and certain terms may not have an identical interpretation in commercial usage. Those parts containing terms relating to individual sections of the industry should be used in conjunction with Part 1. Also included are 2451:1954, Chilled iron shot and grit (2s.); 2452:1954, High pedestal or portal jib cranes (7s. 6d.); and 2454:1954, Determination of magnetic permeability of, iron and steel bars, forgings and castings (2s. 6d.).

Under "Revised Standards Issued" there is B.S. 327, Part 2:1954, Derrick cranes, hand operated (6s.); and under "Amendment Slips" are B.S. 1293:1946, Screen analysis of coal (other than pulverized coal) for performance and efficiency tests on industrial plant. Amendment No. 1 (PD 1823) and B.S. 2064:1953, Dimensions of abrasive wheels and tools, Amendment No. 1 (PD 1818).

Wolverhampton Chamber of Commerce Presidential Address

Mr. H. C. Willson, president of Wolverhampton Chamber of Commerce, in his annual presidential speech on April 2, said that industry and commerce were to-day fighting three antagonists at once, a crushing burden of taxation, increasing competition from Germany and Japan, and the demands by employees of all industries and trades for increased wages.

On the question of company capital and profits, Mr. Willson said that he often wondered why no one had attempted to tell skilled and unskilled labour the amount of capital invested in each of them. In the average industrial unit there was an investment of anything between £600 and £2,000 per working person, from shop labourers to managing directors. On Japanese competition, Mr. Willson said that it was of no use to waste time in complaining. "We must offer better value for the same price or a lower price for the same value," he said. Mr. Willson was re-elected president of the Chamber, and Mr. W. M. B. Furniss and Mr. R. A. Joseph senior and junior vice-presidents, respectively.

Metallographic Detection of Gamma Phase in Beta-Brass

To a Paper presented to the Institute of Metals, the Author, Mr. L. E. Samuels, B.Met.E., gives the following synopsis: Mechanical polishing has been successfully used to detect fine, grain-boundary precipitates of γ phase in a tin-containing β-brass showing intercrystalline brittleness, but evidence of precipitation is found at only a proportion of the grain boundaries. Electrolytic polishing develops diffuse dark lines at all the grain boundaries of this material, but these indications have a ridge-and-groove contour of a type similar to that previously found in several other copper alloys. The development of this contour at a grain boundary known to contain a discrete precipitate of a second phase is unexpected, and indicates that caution is necessary in interpreting this phenomenon.

Shell Moulding Possibilities*

According to Mr. T. W. Curry, of the Lynchburg Foundry Company, Virginia, writing in *Materials & Methods*, firms cannot quote for a tolerance of 0.002 to 0.003 in. per inch as applying to the dimensional tolerances to be accepted for shell-moulded castings. The Author's experience so far with castings in a weight range of ½ to 40 lb. indicates that the following rules should be applied to shell-moulded castings.

(1) If all critical dimensions are in one side of the shell (all in the cope or all in the drag), drawing dimensions within a tolerance of ±0.002 in. per inch can be obtained.

(2) If the critical dimensions are across the joint of the shell mould, or if a core, which is made separately, is set in the mould, then the dimension will be approximately 0.030 in. in excess of the pattern dimension. Some operators have reported as much as 0.060 in. in cases of this kind.

(3) Certain types of castings, such as a wheel with a long, heavy hub, which are poured in the vertical position, require a careful back-up procedure, or swells on the underside of the hub will be encountered.

(4) There must be a means to get the metal into the mould, and if it is necessary to have a gate attached to a surface involved in a critical dimension, an allowance of a minimum of 0.020 to 0.030 in. should be made. Grinding fixtures will materially reduce this allowance, but attention is directed to this operation because some machining is now being done in the foundry.

(5) Out-of-roundness is encountered in some castings, when the critical dimensions are all in one side of the mould. It is particularly troublesome when the castings are poured in the vertical position. Indications are that some eccentricity might be caused by the use of a bottom gate and a riser at the top of the casting. There is a hot area on the vertical diameter caused by this method of gating and risering, and the casting does not have equal cooling rates in all directions.

(6) Straight flat surfaces are difficult to produce. Shell warpage and shell-mould assembly contribute to this difficulty. There is a problem in stripping a straight shell from the pattern and both the mechanical and chemical engineers are working to improve this condition. The characteristics of the synthetic resin used as a binder can be changed materially to produce greater rigidity at the time of stripping, and research in progressing in this direction. Some warpage can be corrected by proper use of the back-up medium and arrangement of the stripping pins. The most efficient way to reduce or eliminate warpage is to apply the same amount of heat during curing on the back of the shell as is applied on the patternplate side.

The dimensions measured from casting to casting are uniformly within narrow tolerances. Reliance can be placed upon duplication of a gear casting within 0.015 in. on the o.d. and within 0.005 in. on the i.d. of the hub. Dimensional uniformity of the casting is a valuable advantage in the machine shop.

Obviously, if good duplication dimensionally is obtained, then it is possible to obtain good duplication within the same tolerances on the drawing dimensions. Makers must gain experience with the process and statistically study dimensions of castings produced in order properly to alter the patterns, joints, and other steps in the process to produce castings within very close dimensional tolerances, found on duplication studies, of those on the drawing.

The dimensions discussed above may appear, in first judgment, to be quite a wide deviation from drawing and that green-sand practice is a good or better one. However, in every case where a casting moulded in green-sand has been replaced with a shell-moulded casting, the shell casting has been better dimensionally and more consistent in shape. Thus, before concluding that better dimensions and uniformity are not obtained by shell moulding, one should statistically study the measurements of green sand castings. It would be well to keep in mind during this study that the ordinary small "pimple" encountered with a bonded 90 A.F.S. fineness sand will stand from 0.015 in. to 0.020 in. above the desired surface.

Some castings seem to be "naturals" for shell moulding, while others present unforeseen problems, and the latter group may prove not to be suitable for the process. Although there are exceptions, generally, as the size of the shell-mould to be poured increases, or the casting size increases, there is a need for greater tolerances on the specified dimensions of the casting.

Finish

The surface finish of shell-moulded castings is noticeably improved over any surface normally produced in green sand, or from a conventional core-sand washed with the coatings now available. The finish obtained is also consistent and is duplicated regularly in production.

Good finish is necessary because it plays a vital part in obtaining the dimensional tolerances cited. Also, a smooth surface has great sales appeal, which is listed by some large potential consumers as the number one advantage of the process. Both, however, go hand in hand and the combination of finish and consistent dimensions is much more valuable than finish alone in subsequent processing of the castings.

Shell moulding is not an automatic means of producing a good surface finish. On the contrary, careful study is required, and the correct application of the sand-resin mixture to the pattern plate is one of the more difficult problems of the process to solve. Here, again, some castings are "naturals" and almost all methods of investing the pattern with any sand mixture produce a smooth surface. There are other castings much more difficult to produce with a good finish because voids in the shell-mould surface occur when the application of the sand is not exactly right. Voids in the shell surface produce a penetration effect, and finish and dimensions are destroyed.

Cleaning Shell-moulded Castings

There have been many reports regarding the cleaning costs of shell-moulded castings, some without foundation and others somewhat exaggerated.

In considering cleaning costs it must be realized that in shell moulding some operations are being moved from the machine shop to the foundry. Also, the castings have closer tolerances than those in castings produced in sand moulds. Of necessity, the tools and methods for cleaning castings must undergo some drastic changes. In particular, special jigs and fixtures must be used.

Cleaning begins at the knock-out stations and here it is necessary to avoid scarring the casting, remove the gates without breaking and palletize the castings for transfer to blasting room. The individual characteristics of the casting then determine whether a table or rotary blasting operation or some other type of cleaning equipment will be used. Ordinary shot mars the good finish already present and special blasting materials are necessary. A 90 A.F.S. sand performs an excellent cleaning job in the blast machine and there may be developments with other materials and cleaning machinery.*

* Extracted from a Paper read before the Gray Iron Founders Association.

* The use of sand for blasting purposes is prohibited in this country.—EDITOR.

Shell-moulding Possibilities

The surface obtained with a shell mould needs only a very light blasting; there should only be grinding at gates and risers; special handling is required; and the grinding must be done in a fixture if the surface is involved in a dimension having little tolerance.

Savings in Machining Operations

It is possible to produce shell-moulded castings at a high production rate with excellent finish and dimensions within close tolerances. The ability consistently to duplicate a shape allows the tooling engineer to design methods to reduce machining costs.

From March, 1953, to the present time (October, 1953) Lynchburg has delivered 32,000 gear castings of the type. The customer reports a saving of 52 per cent. in his machining operations on these castings as compared with the same castings made in green-sand.

A flywheel, which requires machining operations on all surfaces is another example of savings in machining and carriage costs. The clean casting weight, made in green sand, was 80 lb., and it was possible to reduce the shell-moulded casting to 60 lb. This is a great saving in shipping weight in addition to saving the expense of cutting 20 lb. of metal from the casting. Twenty pounds of metal removed from an 80-lb. casting seems an exorbitant amount, yet a very large consumer of forgings, steel, brass, grey iron, malleable-iron castings and bar stock reported after a careful survey that 18 per cent. of the purchased weight of these commodities was removed in the machine shop. This may be in line with the thoughts of some machine-shop operators when they express themselves by saying "when we cut we want to cut." There can be no other result than greater tool wear as the amount of metal to be removed is increased, and the tool cost per unit machined will increase.

In conclusion, shell moulding is a process with a very high potential in quality, production and low final cost, and as knowledge of the process is gained, castings will further improve.

Scotland's Expanding Output

Industrial output in Scotland is expanding rapidly, and last year reached what may be an all-time record. Unemployment in the country, however, although less than it was, is still twice that of the United Kingdom as a whole. The production increase, too, is only 5 per cent. in Scotland compared with 6 per cent. in the rest of the U.K.; but the general picture is one of expansion and development, which shows signs of continuing. These facts are published in the White Paper, "Industry and Employment in Scotland, 1953," published recently (Stationery Office, 2s. 6d.).

Steel output in Scotland last year rose by about 10 per cent., production of crude steel reaching 2,320,000 tons, compared with 2,110,000 tons in 1952. Pig-iron production, at 863,300 tons, was about the same as in the previous year.

In the shipbuilding industry the shortage of steel plate was felt for the greater part of the year, but 477,654 gross tons of new merchant shipping were completed, an increase of 23,000 tons over the previous year. There was a decline, however, in the tonnages of ships launched and laid down. In common with other U.K. shipyards, Scottish yards received fewer orders for new merchant ships than in 1952. Orders for 174,000 gross tons were booked in Scotland, this being 41 per cent. of the U.K. total. The aircraft industry in Scotland now employs about 16,400 people.

Parliamentary

Fuel Efficiency

In answer to MR. PHILIPS PRICE, MR. GEOFFREY LLOYD, Minister of Fuel and Power, said that the directors, general manager, and secretary of the National Industrial Fuel Efficiency Service had been appointed, staff recruitment was proceeding, and the service expected to start operating on May 1.

Asked by MR. PALMER to what extent he proposed to make available to the new organization details of private industrial processes, entrusted to his department by manufacturers and others, when his department fuel efficiency service was brought to an end and the new organization took over, MR. LLOYD replied: "None, sir."

He was asked by MR. RENTON if he was aware that a waste of public money, effort, and educated manpower resulted from the overlapping of functions of the fuel departments of Ministries, of various local authorities, and of the new fuel efficiency service, and what steps he intended to take to secure economies by preventing such overlapping. In reply, MR. LLOYD said that as at present advised he would be glad to consider any information Mr. Renton might care to send him. He could assure Mr. Renton that steps had already been taken to prevent overlapping when certain of his department's responsibilities were transferred to the new service.

The Minister was asked by MR. PRICE whether he had any estimate of the amount of fuel saved in industry over a convenient accounting period as a result of the installation of better plant and employing better heating methods, and whether the improvement in the heating of houses which had been undertaken in recent years had gone to reduction in consumption of fuel or to greater amenities.

MR. LLOYD stated that no estimate was available, but substantial savings had been made. Comparison between the increase in industrial fuel consumption and that of general economic activity showed a saving at the rate of about 3,000,000 tons of coal a year. Improved domestic heating was thought, at present, to result more in increased comfort than in reduced fuel consumption.

When MR. PRICE asked if he could say whether the saving had been greater in industrial or domestic consumption, MR. LLOYD replied: "I would have said in industrial consumption."

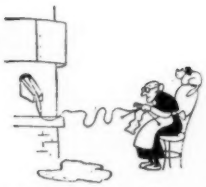
Short Time at Falkirk Foundries

The Minister of Labour was asked by MR. MALCOLM MACPHERSON whether he was aware that a number of ironfoundries in the Falkirk district were now working on short time, and, in view of the recession in the foundry industry in this district in 1953, what measures he proposed in order to avert the recurrence of such a situation.

The industry was suffering from a decline in orders which had caused an increase both in short-time working and in the number of workers temporarily laid off in the Falkirk district, said SIR WALTER MONCKTON, in reply. It was usual for merchants' ordering to revive later in the year, and he was hopeful that this would effect a substantial improvement in the employment situation.

THE President of the Board of Trade replied "No" when Mr. Marquand asked him whether, since the coming into operation of the Iron and Steel Act, 1953, he had referred any activity of iron and steel producers to the Monopolies and Restrictive Practices Commission for investigation.

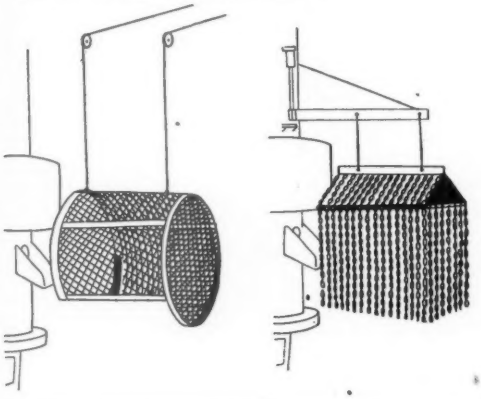
Formation, Prevention and Disposal of Slag Wool in the Cupola



The *Journal of Technical Information* published by the *Centre Technique* for February has an article covering this very interesting subject, and the following is a translation:—

During the running of a cupola, when certain conditions combine relative to the chemical composition of the slag, the blast input, and the temperature of the gas escaping from the slag notch, a part of the slag running away is in the form of fine filaments, known as slag wool.

FIG. 1.—*Cage method; and* FIG. 2, *hanging-chain device for trapping slag wool as it is blown from the slag notch of a cupola.*



Generally speaking, this is an indication of good cupola practice, but there is the disadvantage that this slag wool flies all over the place, causing a certain amount of inconvenience to the men and necessitates frequent cleaning down of the nearby plant and roof members. Steps should be taken to avoid the formation of this slag wool, maybe, to alter its constitution so that it does not float around the shop.

It has been noted that the phenomenon often occurs when the slag notch is too close to the tuyeres. It so happens, however, that it is relatively easy to carry out desirable rectifications. Generally speaking, to reduce to the minimum the production of slag wool, it would seem to be desirable to run the cupola with the slag notch closed. Thus the closing of the notch with a bott of sand and thereby allowing the level of slag to rise above it, would seem desirable. The slagging could thus be carried out every ¾ hr. or so, when the slag level approaches the tuyeres. During the major part of the "blow," the slag runs out, but when the notch is completely botted and the blast does not leave through it, there is then no formation of slag wool. From the moment the slag stops running, the notch is again botted up.

In order to suppress the movement of the slag wool leaving the slag notch, several systems have been proposed. For example, one could cite two which are thought to be new, and moreover are effective. One is a movable metal basket of which the walls are gridded, and which, suspended from two ropes passing over pulleys, is balanced by counterweights. This basket (Fig. 1) is fixed opposite the slag notch and can be easily shifted each time it is necessary to open, close, or attend to the slag-hole. A second method consists of using a screen made up of two rows of chains separated by distance pieces (Fig. 2).

Bronze and Brass Founders' Advisory Service

The next Midlands-area advisory-service meeting organized by the Association of Bronze and Brass Founders for members and non-members will be held at the Victoria Hotel, Wolverhampton, on Wednesday, May 5, at 2.15 p.m. (following luncheon). It has been decided that "foundry layout" should be the topic for discussion. Slides will be shown of foundry layouts actually in operation, in addition to a number of possible layouts. In order to promote discussion on a subject which is of interest to all founders, members of the A.B.B.F. are asked to submit black-and-white plans of their foundries from which slides can be made for showing at the meeting. Such plans should be forwarded to the secretaries, Heathcote & Coleman, 69, Harborne Road, Edgbaston, Birmingham, and they will be kept entirely anonymous. The following information also should be supplied to facilitate intelligent discussion: (i) Tonnage of castings required per week; (ii) number of alloys produced; (iii) sizes and types of castings; (iv) general idea of site limitations (if any), and (v) any further relevant information. The plans should be submitted not later than April 21.

European Coal and Steel Community

After hearing the views of steel producers, the High Authority of the European Coal and Steel Community has published its decision on the scrap price system for the year from April 1, 1954. The price of scrap is no longer to be controlled, but allowed to go free. The organization for importing scrap and for the equalization fund is to continue. Membership of the equalization fund, formerly voluntary, is now made compulsory, steel producers paying contributions to the fund according to their purchases of both home and imported scrap.

The *Office Commun des Consomateurs de Ferraille* will decide the amount of scrap to be imported, the maximum price to be paid for imported scrap, and the amount of the levy. As before, an observer of the High Authority will be present at all the meetings.

Latest Foundry Statistics

According to the British Bureau of Non-ferrous Metal Statistics the output of copper base castings during January and February was 10,382 tons—an increase of 2,000 tons over the corresponding period of 1953. Actually 5,579 tons were made in the latter month.

Institute of Metals Spring Meeting

The 1954 Spring Meeting of the Institute of Metals will be held in London from April 26 to May 1, jointly with the *Société Française de Métallurgie*, with an extension from Sunday to Tuesday, May 2 to 4, for members and ladies of the French Society.

This is the first occasion on which the Institute of Metals (or, so far as is known, any British metallurgical society) has acted as host in the United Kingdom to a foreign metallurgical society, and the Council hopes that members will give this meeting their full support.

Particular attention is directed to the fact that, excepting the May Lecture, all scientific sessions will be held at Church House, Great Smith Street, Westminster, S.W.1 (near Westminster Abbey). The meetings will be held in rooms in which the House of Lords and the House of Commons met during the war. It is requested that all those who intend to take any part in the meeting will notify the secretary, Col. S. C. Guillan, at 4, Grosvenor Gardens, London, S.W.1.

Programme

Monday, April 26

9.30 a.m. to 6 p.m.—Registration of members.

2 to 5.30 p.m.—Coach tour for ladies and members of the *Société Française de Métallurgie;* or 2 p.m., visits to one of the following: (i) British Non-Ferrous Metals Research Association; (ii) British Iron and Steel Research Association; (iii) Britannia Lead Company, Limited; or (iv) Mond Nickel Company, Limited.

6.30 p.m., at the Royal Institution, Albemarle Street, London, W.1. Opening Ceremony. Welcome to members of the *Société Française* by the president on behalf of the Institute of Metals and by Professor Sir Cyril Hinshelwood, foreign secretary of The Royal Society, on behalf of British science.

7 p.m.—May Lecture by Professor L. F. Bates, D.SC., F.R.S. (University of Nottingham), on the "Domain Structure of Ferro-magnetic Metals."

Tuesday, April 27

10 a.m.—Annual general meeting of the Institute of Metals; presentation to the Institute of a presidential badge by the directors of Johnson, Matthey & Company, Limited; installation of the new president, Dr. S. F. Dorey, C.B.E., F.R.S.; presentation of Institute medals and students' essay prices; and presidential address by Dr. Dorey.

12 noon.—Cocktail party.

2.15 p.m.—Visits for members and ladies of the *Société Française*, or:

2.30 p.m.—Scientific session at Church House, Great Smith Street, S.W.1.

6 to 7.30 p.m.—Reception by Her Majesty's Government for members and ladies of the *Société Française* and a limited number of invited members of the Institute of Metals. The Right Hon. Duncan Sandys, M.P. (Minister of Supply), will receive the guests.

Wednesday, April 28

10 a.m.—Ladies (and members) of the *Société Française de Métallurgie*: visit to the Tower of London (including the Crown Jewels) and Westminster Abbey, by invitation of the reception committee.

10 a.m.—Session A: Symposium on "The Control of Quality in the Production of Wrought Non-ferrous Metals and Alloys." Part II.—"The Control of Quality in Working Operations"; or

Session B: Precipitation hardening. A discussion based on five papers; or

Session C: A discussion on four papers on ferrous metallurgy, arranged in co-operation with the Iron and Steel Institute.

2 p.m.—Visits for members and ladies of the *Société Française* to museums, art exhibitions, research laboratories, the General Electric Company, Limited, or J. Stone & Company (Charlton), Limited.

2.30 p.m.—Session A: Symposium on "The Control of Quality in the Production of Wrought Non-ferrous Metals and Alloys." Part II continued; or

2.30 p.m.—Session B: A discussion on creep, covering six papers; or "Some Observations on Creep and Fracture from Investigations on Lead Cable-sheath Alloys," by A. Latin; "Structural Studies of the Creep of Lead," by R. C. Gifkins; "Some Creep Characteristics of a Group of Precipitation-hardening Alloys Based on the Alpha-Copper-Aluminium Phase," by J. P. Dennison; "The Low-stress Torsional Creep Properties of Pure Aluminium," by W. Betteridge.

2.30 p.m.—Presentation and discussion, in French, of the following papers of the *Société Française*: (1) "New Theory of Martensitic Transformation," by Ch. Crussard and J. Philibert; (2) "Phenomena of Overheating in Aluminium Alloys," by Ch. Boulanger; and (3) "Research on Selective Oxidation of Nickel/Chromium Alloys at High Temperature," by J. Noreau and J. Benard.

Evening banquet and dance in the Great Room, Grosvenor House, Park Lane, London, W.1, at which members and ladies of the *Société Française* will be the guests of the Institute.

Thursday, April 29

9.30 a.m.—Ladies (and members) of the *Société*: All-day visit to Windsor Castle; St. George's Chapel, Windsor; Eton College; and Hampton Court Palace.

9.30 a.m. to 12 noon.—Sessions A on recovery and recrystallization; and B on continuous casting or molybdenum and molybdenum alloys and the arc melting of metals.

2.30 p.m.—Visits for members of the *Société Française*, Institute of Metals, and Iron and Steel Institute to: (i) A.P.V. Company, Limited; (ii) British Aluminium Company, Limited; (iii) General Electric Company, Limited, research laboratories; or (iv) the Wallace Collection.

6.30 p.m.—Reception at the French Embassy, for members of the *Société Française* and a limited number of invited members of the Institute.

Friday, April 30

All-day visits for members and ladies of the *Société Française*, the Institute of Metals, and the Iron and Steel Institute to Cambridge colleges; Associated Electrical Industries, Limited (research laboratory, Aldermaston); Enfield Rolling Mills, Limited, and Enfield Cables, Limited; Ford Motor Company, Limited, Dagenham; Fulmer Research Institute, and High Duty Alloys, Limited; Northern Aluminium Company, Limited, and Aluminium Laboratories, Limited (Banbury); or Stewarts and Lloyds, Limited (Corby).

Saturday, May 1

Members and ladies of the *Société Française de* Institute of Metals, and the Iron and Steel Institute. All-day tour to Canterbury or sightseeing in London.

Sunday, May 2

Members and ladies of the *Société Française de Métallurgie* leave London, in the evening, for (*a*) Birmingham, or (*b*) Cambridge, or (*c*) Sheffield, or (*d*) South Wales, where a full programme of works visits is being offered.

Personal

SIR MILES THOMAS, chairman of British Overseas Airways Corporation, has been elected president of the Institute of Shipping and Forwarding Agents.

DR. B. WATERS, who recently returned from America, has taken a position with William Jessop & Sons, Limited, as metallurgist in the research department.

MR. DAVID D. WALKER, managing director and secretary of Evershed & Vignoles, Limited, has been appointed a director of the Iron Trades Employers' Insurance Association and the Iron Trades Mutual Insurance Company.

MR. JOHN ROBSON and CAPT. N. J. H. D'ARCY, R.N. (retd.), have been elected to the board of Alex. Stephen & Sons, Limited, Glasgow, as from April 1. Mr. Robson is the company's naval architect and Capt. D'Arcy has been appointed general manager of the engineering department.

MR. G. A. V. RUSSELL has retired as general manager of the Cleveland works of Dorman, Long & Company, Limited, which he was appointed in 1947. He was formerly general manager of the works of the Steel, Peech & Tozer Branch of the United Steel Companies, Limited.

THE TEMPORARY APPOINTMENT of Dr. J. Pearson as head of B.I.S.R.A.'s Steelmaking Division, in addition to his existing appointment as head of the chemistry department, was announced at the beginning of this year. The dual arrangement is now made permanent and Dr. Pearson is confirmed in his second appointment.

MAJOR-GENERAL G. N. TUCK has been appointed Deputy Controller of Munitions at the Ministry of Supply, with effect from May 17, in succession to MAJOR-GENERAL G. P. WALSH, who has been appointed Assistant Controller of Munitions, a post which he will continue to hold in a civilian capacity after his retirement from military service in the near future.

THEODORE G. MONTAGUE, president of Borden Company, has been elected a director of the International Nickel Company of Canada, Limited. Mr. Montague served as vice-president of the Borden Company, New York, from 1934 to 1937, and has been president since 1937. He is a director of Borden Company, Limited (Canada), and other companies, and now resides at Greenwich, Conn.

DR. P. G. MCCARTHY, works manager of the Billingham-on-Tees works of British Titan Products, Limited, titanium pigment makers, has been appointed personnel manager of the company and will be responsible for labour and staff at Billingham and Grimsby. He is succeeded at Billingham by MR. H. GLENWRIGHT, deputy works manager, who joined the firm 10 years ago. The new deputy works manager is MR. C. D. MARSON.

MR. J. V. DANIEL and MR. E. T. R. BALL have been appointed directors of the British Electric Transformer Company, a subsidiary of Crompton Parkinson, Limited. Mr. Daniel has been joint managing director of Crompton Parkinson since March, 1953. He is also a director of Austin Crompton Parkinson Electric Vehicles, Limited. Mr. Ball has been general manager of the British Electric Transformer works since 1947. Aged 52, he joined Crompton Parkinson in 1928 as a designer in the transformer department.

National Union of Manufacturers' Luncheon

Lord Rochdale, president of the National Union of Manufacturers, said that somehow the burden under which industry and individuals in industry, laboured, had simply got to be lifted if industry was really to gain a sufficient degree of freedom to exploit every opportunity for expansion, when he spoke at the annual luncheon of the Midland Area of the Union in Birmingham last month.

He did not think it could be stressed too often that unless the country was constantly introducing new industries, new and advanced products to take the place of some of the more traditional exports, which many of its erstwhile customers, having been bitten by the world-wide bug of economic nationalism, now insisted on making for themselves, the country would never be able to maintain, let alone expand, as it must, its overall earnings.

The Midland Area president, Mr. W. Blackwell, said that industry and industrialists were being restricted by bureaucratic and political controls, and unless more effective measures were taken to stop the misguided national philanthropy which masqueraded under the name of national insurance, we should be faced with the grim prospect of national insolvency.

At the annual meeting which preceded the luncheon, Mr. C. F. V. Williams, director of the N.U.M., urged an investigation of Government expenditure by an independent committee.

Industrial Association of Wales

Among the new appointments to the North Wales executive committee of the Industrial Association of Wales and Monmouthshire is that of Mr. A. H. Hamer, who is manager of the Rustproof Metal Window Company, Limited, Saltney, Chester.

The following have been appointed to the South Wales executive committee of the association:—Mr. F. W. Alexander, chairman of Lewis & Tylor, Limited, belting manufacturers, etc., of Cardiff; Mr. Donald H. Davies, general manager of the West Wales section of Richard Thomas & Baldwins, Limited, at Gorseinon; Col. R. D. Heseltine, a local director at Swansea of Dawnays, Limited, bridge and structural engineers, of London, S.W.11; Dr. H. Mastin, manager at Newport (Mon) of the British Aluminium Company, Limited; and Mr. Arthur Thomas, a director of Helliwells, Limited, makers of aircraft components, which has branch works at Treforest (Glam).

THE President of the Board of Trade told Mr. Osborne that he had now received the report on the duty-free entry of machinery into the United Kingdom. The subject was difficult and complicated, and he was considering it in detail. He was not yet in a position to say when the report would be published or what action would be taken on it.

REPLYING to Mr. Robson Brown, who asked what the total cost to the Customs and Excise would be if the duty on heavy carbon oils and petrol, respectively, were reduced by 6d. per gall., the Financial Secretary to the Treasury said, allowing for some consequential increase in consumption, the cost to the Exchequer of a reduction by 6d. a gall. in the duty on hydrocarbon oils would be approximately:—Heavy oils used as fuel in Diesel-engined road vehicles, £8,000,000 a year; petrol and other light hydrocarbon oils. £42,000,000 a year.

News in Brief

PERMISSION was granted, from April 7, for carbon blacks to be imported freely from Eastern Europe.

IT IS ANNOUNCED that Stanton Ironworks Company, Limited, of Stanton-by-Dale, Derbyshire, have decided not to exhibit at this year's British Industries Fair.

AN OFFICE of Clarke, Chapman & Company, Limited, marine engineers, boilermakers, etc., of Gateshead, is to be opened in Montreal to develop business with Canada.

A NEW EXTENSION of the National Physical Laboratory's metallurgy division was opened at Teddington last week by Sir Lawrence Bragg, F.R.S., a former director of the N.P.L.

A ONE-DAY Lancashire and Yorkshire Regional Conference is to be held at the Engineers' Club, 17, Albert Square, Manchester, 2, on Saturday, April 24, 1954, from 10.15 a.m. to 4.30 p.m.

THE FOUNDATION-STONE of the new Oxford College of Technology, Art, and Commerce was laid by Lord Nuffield at Headington Hill on April 5. The first part of the college will consist mainly of workshops and laboratories for engineering and building.

" MAYBE IT'S BECAUSE WE'RE LONDONERS " is used by Eyre Smelting Company, Limited, Tandem Works, Merton Abbey, London, S.W.19, to introduce their calendar, beginning April/May. Reproduced are six typical London scenes, the first a photograph of a Covent Garden flower stall.

THE GOODWILL that fine British craftsmanship was creating overseas could be undone by the failure to provide an efficient after-sale service, Lord Mancroft, Lord in Waiting and Board of Trade spokesman in the House of Lords, warned the Jersey Chamber of Commerce on April 3.

THE EARL OF DUNDEE opened a new Museum of Industries in Dundee recently. Among the companies represented at the museum are Burndept-Vidor, Limited, battery manufacturers, Veeder-Root, Limited, makers of counting mechanisms, and the National Cash Register (Manufacturing) Company, Limited.

THE SECOND of three pairs of dock gates ordered by the Port of London Authority and built by Head, Wrightson & Company, Limited, Thornaby-on-Tees, has been launched and despatched by sea to the Thames Basin. The third pair is expected to be completed in about three months' time.

LONG SERVICE AWARDS to 26 employees of James Booth & Company, Limited, and the associated firm of John Wilkes, Sons, and Mapplebeck, Limited, were presented at a dinner at the Kitts Green Works on April 3 by Dr. Horace W. Clarke, the managing director of the group. All the recipients had been with the firms for 25 years or longer. Their aggregate length of service is 650 years.

PRODUCTION OF PIG-IRON in the area had gone up by 1,400 tons a week and of steel ingots by 5,200 tons a week, Mr. C. Senior, divisional secretary of the Iron and Steel Trades Confederation, told a conference of North-East Coast delegates at Redcar. Plate-mill workers had voluntarily extended their normal working week to meet a heavy demand from the shipbuilding industry and the result was an increase of 10 per cent. in the output of steel plate.

THE FIRST of a number of productivity teams which the French Government is sending to the United Kingdom arrived on April 4 for a week's study of trade union work and organization. It is expected that other teams will visit the U.K. during the summer and their subjects of study will include prefabricated buildings, earth-cement roads, prevention of industrial accidents, employment of the physically handicapped, iron and steel production, and plant for power production.

JAMES NORTH & SONS, LIMITED, of Hyde, Cheshire, announce a further addition to their range of industrial protective gloves. This is the new red P.V.C. fabric-supported lightweight (type 725) glove. This glove is claimed to have up to 15 times longer life than the industrial cotton and lightweight leather glove which it replaces. A special feature claimed is increased flexibility and sensitivity of touch permitting the fast manipulation and assembly of small parts.

SOME 80 Old Hill manufacturers are making plans to oppose the re-zoning of an industrial area amounting to 22 acres for residential purposes. The proposals to remove these firms, some of them foundries, to another part of the district is a feature of the Staffordshire County Council's development plan. A committee has been set up by the manufacturers concerned, consisting of six members, to organize opposition to the scheme, and a public inquiry is expected in the near future.

AT LEEDS ASSIZES, last month, agreed damages of £11,000 were awarded to Mr. Arnold Clarkson, of Sheffield, who had alleged negligence against the English Steel Corporation of Sheffield. On April 18, 1953, Mr. Clarkson, who was a fitter's labourer, was crushed by a steel pan which fell on him from an overhead crane while he was employed at the firm's Grimethorpe works. He suffered multiple injuries, and as a consequence was now paralysed in both legs and confined to a wheel chair.

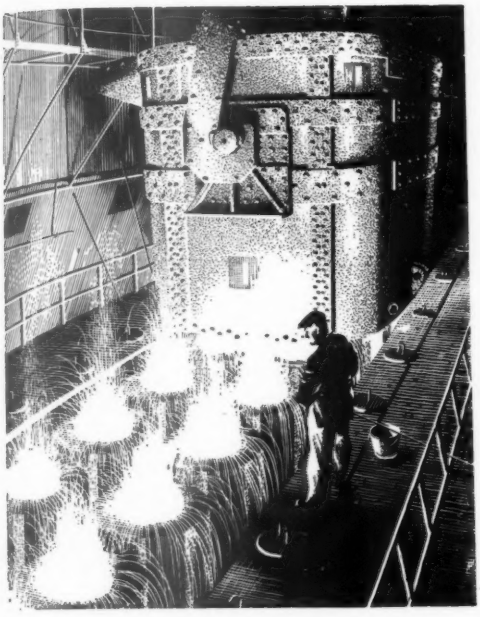
THE MINISTER OF SUPPLY, Mr. Duncan Sandys, M.P., will open the fourth Mechanical Handling Exhibition and Convention at Olympia, London, to be held from June 9 to 19. All space has been taken up for the Exhibition, the world's largest and most comprehensive display of labour-aiding and ancillary equipment, 75 per cent. of which will be working. At the Convention held in connection with it, eleven papers by authorities in their differing fields on various aspects of handling will be presented.

THE INSTITUTION OF NAVAL ARCHITECTS announces that a research scholarship of the value of £400 per annum and tenable for two years has been offered by the Aluminium Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the institution, and it is hoped to make an award in September. Full particulars of entry, which closes on June 30, can be obtained from the secretary of the institution at 10, Upper Belgrave Street, London, S.W.1.

RECOVERY OF METAL from the old battleship Warspite is reported to be making steady progress. The 31,000-ton ship is lying some 700ft. from high-water mark off Marazion beach in Cornwall, and her owners, Wolverhampton Metal Company, Limited, hope that she will be brought closer inshore with this month's spring tide. The vessel was swept onto the rocks off Mount's Bay seven years ago when she was being towed from Portsmouth to the Clyde for breaking up. All the steel that is reclaimed will be sold to the British Iron & Steel Corporation, Limited.

AT the two-day conference on April 3 and 4 of the Institute of Personnel Management at the University College of North Staffordshire, Keele, Sir Godfrey Ince, Permanent Secretary to the Minister of Labour and National Service, said that incentives for increasing production were essential in Britain, as much in

(*Continued on page* 458)



More steel... less fuel

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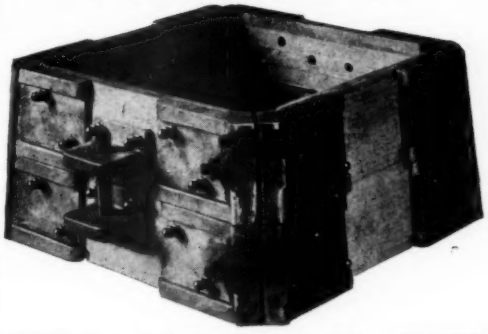

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News in Brief

(*Continued from page* 456)

times of full employment as in times of unemployment, and were of international importance if living standards were to be raised throughout the world. The ideal incentive was that of giving service, he said. That ideal, however, was a long way off. Human nature had to be dealt with as it was found. Some workers responded to material incentive, others to ethical, emotional, psychological or spiritual incentives.

THE Commissioners of Customs and Excise have been advised that all forms of zinc dust and powder (including " blue powder " and other forms of dust and powder obtained directly from the distillation of zinc ores) are properly chargeable with Customs duty on importation into the U.K. at the rate of 20 per cent. *ad valorem* under Group VII (2) of the Schedule of Duties in Part 3 of the Customs and Excise Tariff. This ruling, in so far as it is not already applied in practice, will be brought into effect as from May 1. On and after that date, all importations of zinc dust or powder must be entered for Customs purposes, and duty paid, in strict accordance with the legal position as set out above. Any entries and home use warrants describing these goods as being liable at lower rates of duty will not be accepted.

Company News

TUBE INVESTMENTS, LIMITED—The company is the first sole director and manager of a new private company registered under the name of Resilion Company, Limited, with a nominal capital of £100 in £1 shares, which is to carry on the business of manufacturers of and dealers in all kinds of components and parts for pedal cycles, motor cycles, motor-cars, aeroplanes, boats and other vehicles, etc.

G. & J. WEIR, LIMITED, engineers and founders, of Glasgow—With substantially increased profits in the year 1953, the company is raising the annual total from 17 per cent. to 21 per cent. with a 16 per cent. final recommendation on the £2,018,307 capital. After tax provision of £1,546,742, compared with £865,194 previously, the net profit of the group is £804,269, against £570,398 in 1952. The parent company's net profit expanded from £380,312 to £491,375.

SANBRA, LIMITED, sanitary engineers and brassfounders, of Birmingham—Group profits for the year 1953 have fallen sharply, but the board announces a final dividend of 15 per cent., making 20 per cent. on capital increased by 33⅓ per cent. scrip issue. An interim dividend of 7½ per cent. on smaller and final of 15 per cent. on present capital were paid for 1952. Consolidated trading profit, etc., amounted to £112,046 compared with £246,795 in the previous year.

H. & J. HILL (WILLENHALL), LIMITED, malleable and soft grey-iron founders—The chairman, Col. C. A. B. Lindop, says that in the last nine months of 1953 scheduled orders were held back, inquiries diminished, and orders became extremely difficult to secure even at a much reduced price. He reports a slight improvement in certain directions, but rises in raw-material prices and further wage demands have all had to be met out of profits, as with increased competition it has not been possible to advance selling prices.

PROJECTILE & ENGINEERING COMPANY, LIMITED, London, S.W.8—The dividend for the year 1953 is 20 per cent. and net trading profit £210,583, against £174,912. Subject to C.I.C. consent, it is proposed to issue a capital bonus to ordinary shareholders of one £1 6 per cent. cumulative non-redeemable preference share for every four ordinary shares held. The directors state that the company's post-war plant replacement and modernization programme has now been substantially completed and they are therefore transferring the balance of the special depreciation reserve of £70,874 to general reserve, which at December 31, 1953, stands at £500,000.

A. REYROLLE & COMPANY, LIMITED, manufacturing electrical engineers, of Hebburn (Co. Durham)—A final dividend of 7½ per cent. for 1953 on £3,052,941 ordinary capital is proposed by the board, which paid an interim of 6¼ per cent. on £2,035,294 last September. A special capital distribution of 2½ per cent., not subject to income-tax, on £3,052,941 ordinary, out of a surplus realized by the sale of an investment, is also recommended. For 1952 a final of 7½ per cent., to make 12½ per cent., was paid on the lower capital of £2,035,294. The year's net profit, after providing £1,888,153 for taxation, was £1,159,105, compared with £907,506 for 1952, when the tax provision was £1,817,895.

BIRFIELD INDUSTRIES, LIMITED, general engineering suppliers, of Birmingham—Consent of the Capital Issues Committee has been granted to the proposed 200 per cent. free scrip issue of ordinary stock, involving the capitalization of £530,000 from reserves. At a meeting on April 28, resolutions to be proposed include the removal of the existing 20 per cent. annual ordinary dividend limitation while any preference is outstanding. On the severance of the financial connection between the Birfield group and the Dana Corporation, of America, an agreement has been entered into providing for the interchange of technical information and patents for a period of 25 years. Mr. Charles A. Dana and Mr. Ralph E. Carpenter have now ceased to be directors.

B.I.F. Briefs

New items or articles of plant and equipment of interest to founders and engineers, which will be on show at this year's British Industries Fair, Castle Bromwich section, May 3 to 14, are included in the following paragraphs:—

AT CASTLE BROMWICH, on stand B.329, G. A. Harvey & Company (London), Limited, will be showing in addition to steel equipment, a wide range of their heavier products, including heavy steel plate work, perforated metals, woven wire, wirework, and sheet-metal work. The company also have a stand at Olympia (G.36), where office furniture will be exhibited.

A 116-LB., 60-H.P. portable gas-turbine engine—developed from that used experimentally by the Rover Company, Limited, in the world's first successful gas-turbine-powered motor-car—will be shown by Rover Gas Turbines, Limited, at the Castle Bromwich section of the Fair (stand D.605). This is the first small industrial gas turbine to go into production in Britain.

ONE OF THE SEVERAL new home-heating appliances which the Radiation Group are showing for the first time at the British Industries Fair (stand 400/501) suggests that thousands of British firesides will acquire a " new look " in the autumn; another does away with the fireside altogether. These appliances are the Parkray free-standing convector fire with back boiler and the new oil-fired version of the Group's revolutionary system of whole-house warming by ducted warm air. Other new appliances include the Yorkist No. 20, a new oven-over-fire grate, and light-weight pressed-steel radiators. A comprehensive range of free-standing cookers, heating stoves, inset fires and domestic boilers will also be displayed.

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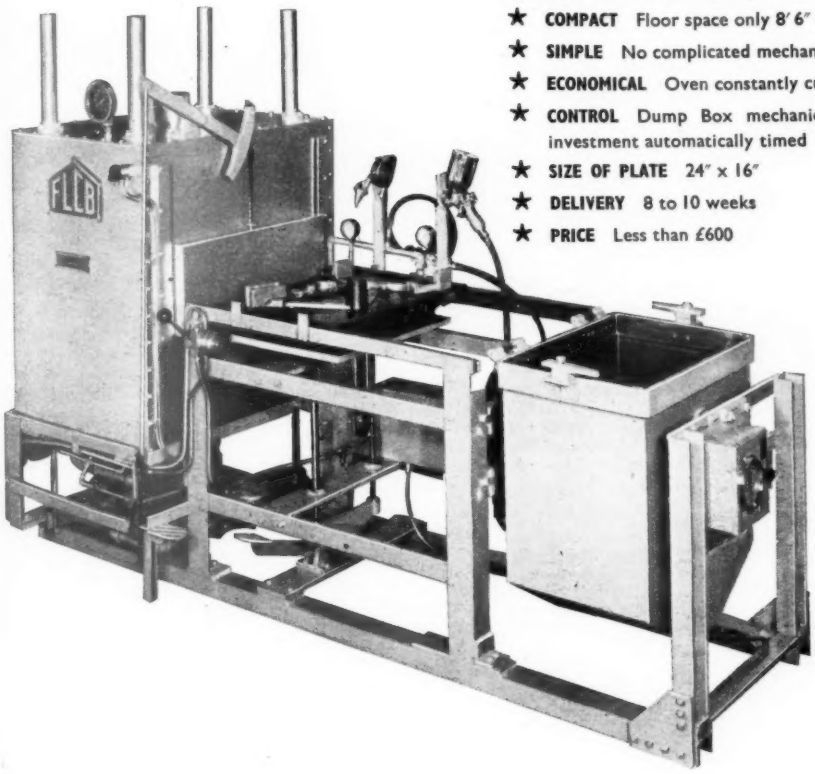

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A development of the "Shelmolda Senior" and "Junior" models, the "Shelmolda Duplus" brings high speed moulding and the advantages of automatic control by an unskilled operator, to the smallest foundry. To suit the requirements of individual foundries, the "Senior" and "Junior" models will still be available.

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Raw Material Markets

Iron and Steel

The continued importation of pig-iron from European ports and occasional withdrawals from stock are clear indications of the pressure on blast-furnace capacity. The light and jobbing foundries are not particularly busy and supplies of No. 3 foundry iron are obtainable without much difficulty. The hematite position is also a little easier, but requisitions from the engineering foundries for low- and medium-phosphorus irons cannot be fully satisfied, while the output of basic iron is barely sufficient to meet the needs of the steel plants. To achieve a better balanced production of iron and steel, more blast furnaces are in course of construction, but some time must elapse before any more of these will be available for operation.

The most striking feature of the trade in semi-finished steel is the sharp contraction in the tonnages of foreign material arriving in British ports. To Belgian steelmakers, in particular, the loss of this trade has been almost catastrophic, although it is, of course, the anticipated consequence of the rapid expansion of home production. British makers are now able to provide the great bulk of the material required by the sheetworks and re-rolling mills and only small marginal tonnages are now coming in from the Continent. The depression in the re-rolling industry has further restricted the demand for prime billets, but there is still a good market for sheet bars and slabs.

Most of the heavy steel mills have a considerable volume of specifications in hand, and the pressure for plates and sheets has not been relaxed in the slightest degree. The further expansion of plate-mill capacity is planned, but will not mature for some time to come, and in the meantime the increase in production has only been achieved by the voluntary extension of working hours. Buyers of black and galvanized sheets are placing orders for delivery in the third quarter of the year, but prompt supplies of joists and sections are now available.

Non-ferrous Metals

Both copper and tin showed great strength last week, while zinc and lead were fully steady, making modest gains in fairly active trading. In tin there is still a real shortage of metal for the early position and the backwardation had widened slightly to £30 on Friday, when the week closed with a gain of £42 in cash and of £39 in three months. After all it seems that France and Germany will elect to sign the agreement and this news helped the market last week. Tin has certainly shown itself to be a very spectacular market recently; this week opened with a jump of no less than £48 10s. in the official price for cash metal on Monday, when the three months position went up by £47; on Tuesday, however, prices fell by £30 and £20, respectively.

In copper, the rise appears to have been based on consideration of the serious situation in Indo-China, but it was also due to heavy buying by Western Germany, where inquiries were sent out for delivery in the summer months. In the United States the Custom smelters price advanced by 25 points to 30 cents, but it can hardly be thought that the movement will go any further. In London there were gains of £10 in cash and £6 5s. in three months, the backwardation widening to £11 10s. Copper closed last week at the highest level since last October. April zinc gained 2s. 6d. and July 5s., while in lead the corresponding increases were 10s. and 12s. 6d.

Figures published by the British Bureau of Non-Ferrous Metal Statistics in respect of February show that consumption of copper was 42,667 tons, of which 31,951 tons were virgin and secondary refined grades. The total was much the same as in January. Stocks of virgin copper in the United Kingdom at February 28 were virtually unchanged at 60,084 tons. In zinc, stocks appreciated by some 2,200 tons to 37,646 tons, while consumption, virgin and secondary, amounted to 25,286 tons. Usage of lead showed only a small gain at 25,837 tons, of which about 6,000 tons comprised scrap and remelted metal. Stocks of virgin lead were about 2,000 tons down at 30,697 tons. Tin consumption improved by only 10 tons to 1,673 tons, but there was a big jump in exports and re-exports to 1,242 tons, of which nearly one-half went to the United States. Stocks of tin fell rather sharply from 3,530 tons to 2,728 tons.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* April 8, £236 10s. to £237 10s.; April 9, £241 to £241 10s.; April 12, £249 to £250; April 13, £244 to £245.

Three Months: April 8, £228 15s. to £229; April 9, £230 10s. to £231; April 12, £237 to £238; April 13, £233 to £233 10s.

TIN, Standard—*Cash:* April 8, £762 10s. to £765; April 9, £766 10s. to £767 10s.; April 12, £815 to £825; April 13, £785 to £787 10s.

Three Months: April 8, £727 10s. to £728 10s.; April 9, £738 to £739; April 12, £785 to £795; April 13, £765 to £770.

ZINC—*April:* April 8, £79 to £79 5s.; April 9, £79 7s. 6d. to £79 10s.; April 12, £81 to £81 5s.; April 13, £80 15s. to £81.

July: April 8, £77 15s. to £78; April 9, £78 5s. to £78 10s.; April 12, £80 to £80 5s.; April 13, £80 to £80 5s.

LEAD—*April:* April 8, £92 5s. to £92 10s.; April 9, £93 to £94; April 12, £97 to £97 10s.; April 13, £95 5s. to £95 10s.

First half July: April 8, £90 15s. to £91; April 9, £91 15s. to £92; April 12, £94 10s. to £95; April 13, £93 to £93 5s.

Tungsten-ore Prices Up Again

The Ministry of Materials has raised its selling prices for tungsten ores of standard 65 per cent. grade and ordinary quality still further.

The new prices, which came into operation on Tuesday, are as follow:—Wolframite, from 175s. to 200s.; scheelite, from 170s. to 195s. per ton, delivered consumers' works.

Latest Foundry Statistics

The weekly average tonnage of liquid steel for the making of castings was in February—according to the Bulletin of the British Iron and Steel Federation, 11,000 tons as against 10,600 in January and 11,600 tons in February, 1953. Of the 11,000 tons melted, 2,730 tons were alloyed, whilst in January this year the average weekly production of finished steel castings was 6,000 tons. On February 6, in ironfoundries, employment was 140,871, an increase of 23 over January, but a decrease in males of 35.

THE President of the Board of Trade replied "No" when Mr. Marquand asked him whether, since the coming into operation of the Iron and Steel Act, 1953, he had referred any activity of iron and steel producers to the Monopolies and Restrictive Practices Commission for investigation.